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The Chemical Age 5 May 1951

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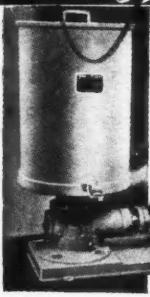

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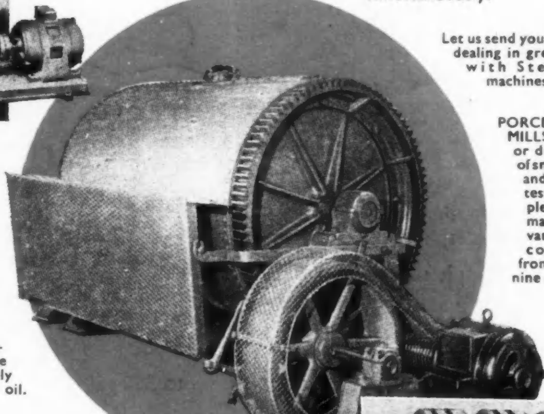

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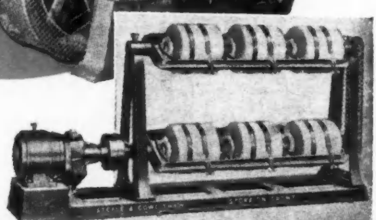

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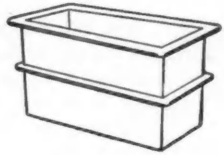

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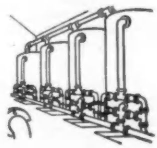

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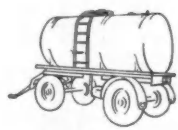

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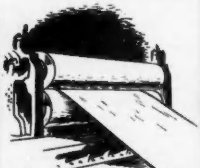

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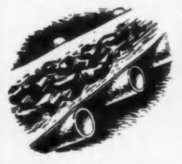

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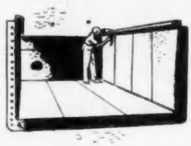

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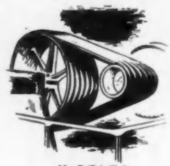

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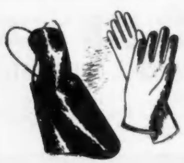

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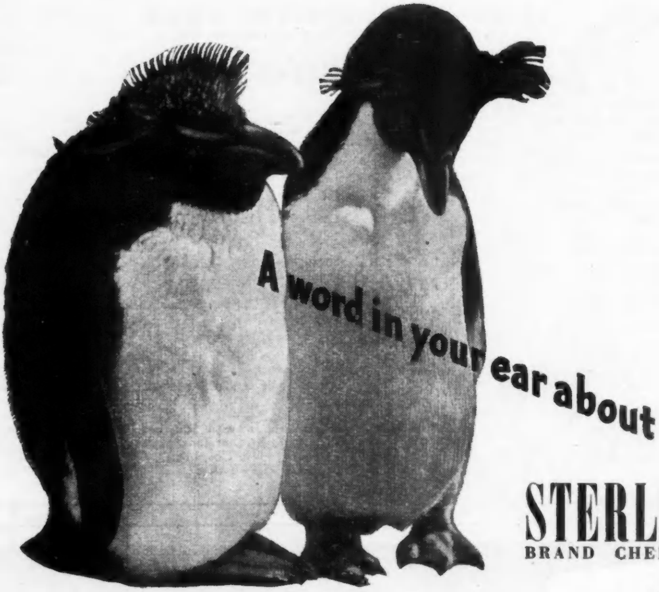

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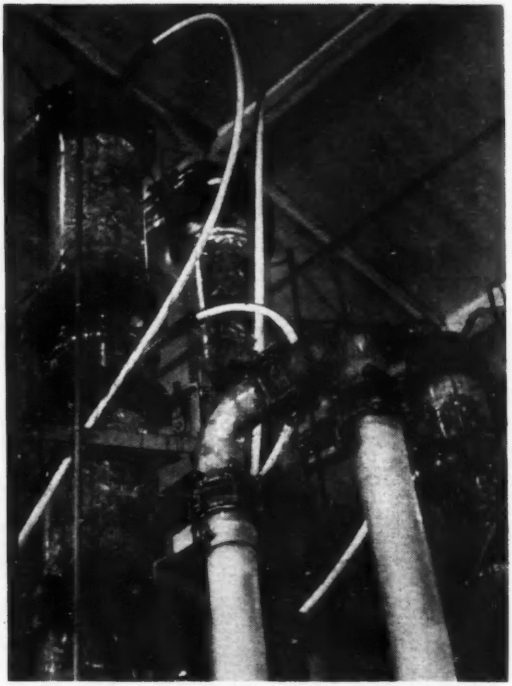

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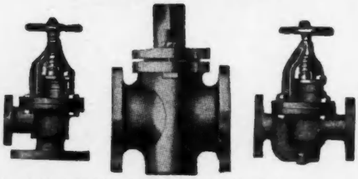

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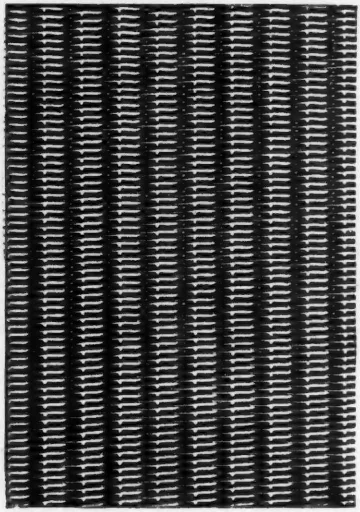

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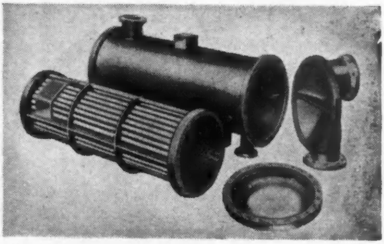

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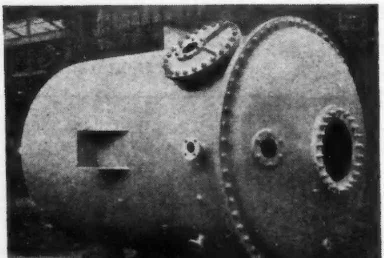

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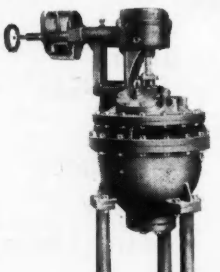

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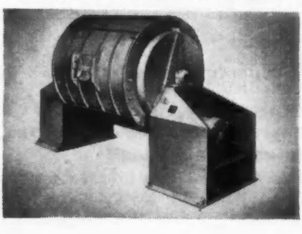

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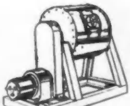

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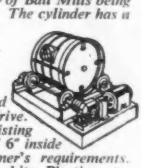

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Volume LXIV | 5 May 1951 | Number 1660

A Chemical Cabinet

THERE are two main causes of shortages of chemicals. The first is a sudden increase in usage to meet conditions of emergency such as war, or the rapid development of a new industry such as plastics. Glycerine and phenol are familiar examples. The second is the inadequacy of natural resources to meet ordinary demands as we have today in the case of sulphur. Both, of course, may operate together, *e.g.*, as evidenced by the instance of wolfram during the war. The specific problems of shortages have exercised the minds of experts in Government and industrial circles for some time, and recently the pressure has been greatly increased by the necessities of strategic stockpiling. The impression exists, however, that all these problems are regarded and tackled on an *ad hoc* basis. The general question of shortages of raw materials and finished chemicals does not appear to be receiving the systematised study it deserves.

This assumption may, of course, be erroneous, for such is the complexity of Government departments, scientific associations and trade organisations interested in chemicals that it is impossible to be aware of all that is going on. The 'British Imperial Calendar and Civil Service List' for 1951 contains 1,262 pages and lists just short of 50,000 Civil Servants by name. It enumerates a host of Ministries and departments which may have an interest in chemistry. Indeed the ramifications of the industry are now so wide and varied that it would probably be shorter to list the departments without any chemical interests whatever, than those whose activities impinge somewhere on the chemical world. The recently published annual report of the Department for Scientific and Industrial Research tells of active work on sulphur supplies, and it may be in connection with the DSIR, or perhaps the Ministry of Supply, or Board of Trade, there is some high level committee studying the general problem of shortages on a long-term basis. If so, then the best of good fortune to them. It may be that somewhere among the conclaves of the industry this is already a subject of co-operative study, but, if so, it has escaped our notice.

With the possible exception of electricity, nothing in the last hundred years has caused such changes in our daily lives as the growth of the chemical industry. Readers of THE CHEMICAL AGE need no proof of this. Nor will they require demonstration that chemistry is expanding in every direction, and with such speed that our journal's title is indeed the proper label for the period of today. But the argument must be

taken a little further. Such expansion as we see all round us means ever increasing consumption of raw materials. Is it sufficient to wait for each threat to become a reality before counter-measures are to be devised, or should an attempt be made now to foresee and forestall the difficulties of a decade hence? The answer seems clear. The *ad hoc* method has, of course, solved many problems and often brilliantly. The German fixation of atmospheric nitrogen in 1914-18 will be recalled as an example. But the goad of urgency is a costly spur, and when time is precious disaster may anticipate discovery. Admitting that the exigencies of war overshadowed every other consideration the present sulphur shortage might well have been foreseen ten years ago, and at least some measures started which would have lessened the gravity of the threat to so large a proportion of the industry.

In America the word 'chemurgy' is growing in currency. It covers the production of raw materials for the chemical industry from farm produce. Development in this field, of course, not only benefits the chemist but the farmer as well. The term could be expanded to cover the utilisation of industrial wastes for which no use has yet been found. So far there is little evidence that the idea has aroused equal interest in Britain, though we hope we are wrong.

This is not the place nor is there space to go into the details of a possible solution to the general problem. It must suffice to suggest but an outline. Is it not time for the formation of a Chemical Cabinet of the best brains in chemistry to anticipate chemical strategy and tactics over, say, the next quarter-century? (The name 'Cabinet' has been used to indicate the desirability of small size and high potential for the group.) Such a body could co-ordinate information and statistics now available, initiate research into chemurgic and other replacement methods, indicate aims and requirements to such organisations as the Colonial Development Commission, stimulate industrial firms to undertake development work, and, above all, advise the Government on the situation and problems of national and world chemistry. Some work of this kind is, of course, being done. All sorts of committees are investigating insecticides, preservatives, oils and the like. It is even rumoured that at times several committees have been engaged on the same question unknown to each other. But the general problem requires more than this. Chemistry plays too big a part in civilised life for its major issues to be treated in patchwork fashion. Further, its implications and language are increasingly difficult for the politician and lay administrator to understand. It appears self-evident that all industry, and that is equivalent to saying our civilisation, is dependent on chemistry, so to anticipate and safeguard the needs of chemical production is an inescapable necessity. There are probably several ways to tackle the problem, but one at least would be a small but high powered 'Chemical Cabinet'.

On Other Pages

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Notes & Comments

Sulphur Allocations

MANY British industries will hear with relief that America has once again dug deep into her own pocket and with her new-found sense of international responsibility brought out handfuls of the sulphur that is as vital to her as it is to us. Based on a revised allocation of 95,000 tons per quarter, the Board of Trade have announced that they are putting into effect their detailed rationing scheme for an assumed consumption of 100,000 tons per quarter. In general, they say, this will mean that users will receive supplies varying from 80 to 90 per cent of their 1950 consumption, except for the superphosphate industry which will continue at its present rate of two thirds of capacity, and key industries which will be maintained at full output (iron and steel, explosives, etc.). This is a very different picture from the glum outlook predicted a few weeks ago on the basis of a 81,000 ton allocation, and even though the rayon industry will still have to be cut by 20 per cent, this is not so bad as the possibility of a 40 per cent cut. As the *Financial Times* of 27 April comments, this welcome breathing space will not only give a little more time for other recovery schemes to be put into operation, but it will also enable economy schemes to be instituted in such processes as steel pickling and superphosphate manufacture, and allow industries to look tentatively round for any small sources of supply outside America. The increased allocation is, however, only a palliative, as industrialists well realise, and does not hide the fact that the ultimate conversion of plant is still a necessity. For once in his life, man shows signs of exhausting the resources of nature. Plant conversion to a more complicated process, however, is a futile and expensive business. Manufacturers who view with alarm the conversion of this country's entire sulphur-burning capacity to pyrites extraction and other processes may well pause in their anxiety and look for a moment at the equivalent problem facing America. Her consumption of the element is fifty times our own. When Texas runs dry, as experts say it will in a matter of years, there are no neighbours who can help her out with increased allocations. She owns the stuff. Unless the West finds new deposits or complete independence from her present ones, we shall all sink together.

Non-Ferrous Metal Research

MUCH valuable investigation carried out during the year is recorded in the 31st annual report, just published, of the British Non-Ferrous Metals Research Association. The most notable event was the re-occupation in February 1950, of the reconstructed laboratory block in Regnart Buildings. The new layout and additions enabled an expanded programme to be more efficiently accomplished, but the expenditure incurred has naturally proved a strain, and must to some extent, curb any expansion of work for the time being. The future is bound to be somewhat uncertain, particularly with the shortage of raw materials and its inevitable repercussions on membership and staff. It is indeed to be hoped that the leaders of the non-ferrous metals industry will continue to support to the best of their ability the association and all its undertakings. Without its aid the gap between the production of a research result and its application in industry would be far harder to bridge. One example of the association's help is that it hopes shortly, through the agency of the DSIR, to obtain an American production control quantometer to determine the possibilities and limitations of direct reading equipment of this type for routine control analysis. The equipment ordered is designed to deal with the routine analysis of copper-base alloys and additional equipment has been obtained which can be adapted to the analysis of other non-ferrous metals. It is hoped that experience gained from this type will provide information for members as to whether such equipment is an economic proposition for their individual routine control purposes. The non-ferrous metal industry is in a sense heterogeneous. Sections of it, and individual firms within the same section, frequently compete for markets, but these minor differences

are absorbed in the major interests of the industry as a whole. The association in its work of exploring and furthering the common interests of producer, manufacturer and user deserves every encouragement, particularly in the present difficult times, if the industry is to continue to develop and prosper.

By-product Radioactivity?

A REPORT published in late March in the United States has drawn attention to a little-known problem of atomic piles, the production of 'waste' radioactive material or what the American Atomic Energy Commission calls 'gross fission product.' This material is a mixture of many isotopes ranging from 72 to 162 in atomic weights—strontium, yttrium, zirconium, barium, cerium, etc.—and it is said that a considerable proportion of these are radioactive isotopes. Hitherto this waste material has been disposed of by storing it in underground concrete vaults, but there is obviously a limit to this method. The Stanford Research Institute has been told to investigate uses for the 'hot' waste from nuclear reactors. Broadly, industrial applications are required in which radiation rather than specific and pure radio-isotopes can be utilised. The cost of the crude mixture would be low—probably less than one dollar per curie. Partial refinement to remove non-radioactive matter would double the cost.

A number of ideas have been put forward. Gamma radiation has a powerful lethal action upon micro-organisms. It might be used for cold-sterilising foods and serums. The less penetrating beta radiation could be applied fungicidally for surface sterilisation of mould or mildew susceptible materials. Radiation can be used catalytically; it accelerates reactions in which the free radicals take part. Polymerisation, halogenation, and oxidation are all promoted by radiation. Laboratory reactions which cannot at present be converted into economic commercial processes might readily become large-scale operations with crude or semi-refined 'gross fission product' as a catalyst. One specific possibility is the production of oxygen, hydrogen, and hydrogen peroxide from water by radiation treatment.

Ice plus Chemicals

ONE of the principal problems of the fishing industry is the maintenance of fresh condition of the catch despite the lengthening distances between fishing grounds and ports. One almost absolute solution to this problem is the construction of trawlers that are virtually floating refrigerators and fish processing factories, but the capital requirement for this is high; though technically feasible, the general development of our fishing industry along these lines may not be economically possible. The customary practice of ice stowage is likely to continue for the majority of our fishing vessels; nevertheless, for many popular types of fish the period during which good condition can be maintained seems limited to six days. Little attention seems to have been given to the possibility of extending this period by using chemical preservatives as well as ice. In Canada some progress has recently been reported in which the use of sodium nitrite as a 0.1 per cent addition to the ice lengthened the period of freshness maintenance by three or four days; at 0.15 per cent concentration the extension was as much as seven days. The publication of this Canadian work was followed by a letter in *Nature* last year (*166*, 4223) which revealed that unpublished British research with sodium nitrite had made some progress by 1941 when it had to be abandoned for more urgent tasks. It would appear that this research had not been revived even in 1950.

In the American fishing industry chemical additives to ice have already passed the research stage and are being commercially distributed. One such product is a mixture of sodium benzoate, a choramine, and salt; a newer product offered this year is a fifty-fifty mixture of sodium benzoate and fumaric acid. There seems to be considerable prejudice in this country against the idea of using chemicals as well as cold storage methods for fish preservation; yet fish is an exceedingly perishable article of food, becoming objectionable through off-flavours and odours before it has suffered any significant loss in food value. It is to be hoped that prejudice has not stood, and is not standing now, in the path of research.

Britain's Latest Fertiliser Factory

Production of Triple Superphosphate at Immingham

GLEAMING white in the bright sunshine the big modern factory stands out prominently against the low-lying Lincolnshire landscape. For a short time it appears as illusive as a desert mirage, for the approach from Grimsby twists and turns so that at one moment the buildings are so close that the journey must be almost ended, yet at another moment, a couple more bends in the road and the goal looks further away than ever!

Turning up from the quayside, however, any sense of illusion is quickly dispelled for here stands solidly and impressively, covering some 45 acres, the latest of Fison's factories, a proud specimen of British achievement in chemical engineering and architecture, including the first triple superphosphate plant in this country.

This great project was decided upon by Fisons, Ltd., in 1944, following an appeal by the Government to the fertiliser industry to submit plans for making this country as independent as possible of imported supplies of superphosphate for agriculture.

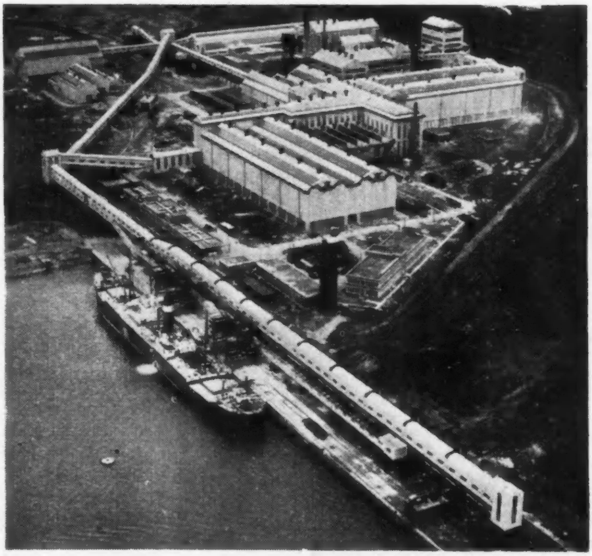
Selection of a site required a long and thorough search and finally Immingham with its sea, rail and road facilities was chosen.

In 1945 the site was an unprepossessing waste of weeds and rushes. To carry the enormous buildings and the plant they would house, nearly 6,000 piles had to be driven into the ground to an average depth of 35 ft. Close watch was kept on the settlement of the process buildings as the weight of structure and plant was gradually added. The greatest settlement observed was only $\frac{1}{8}$ in.—a very satisfactory result considering the poor subsoil bearing capacity.

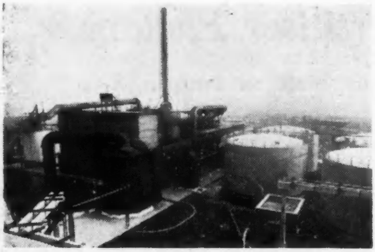
The buildings fall into four main categories: process, storage, utility and administrative. The process buildings are those housing the sulphuric acid, grinding, single superphosphate, phosphoric acid, triple superphosphate, batching and granulating plants.

Designed by Simon-Carves the sulphuric acid plant is one of the largest single unit contact plants in Europe, burning 83 tons of sulphur a day, and employing vanadium pentoxide catalyst in a four-pass converter. The waste heat is used to generate superheated steam, which is fed to the power station, and makes a major contribution to the economics of the factory.

Rated to produce 250 tons of 100 per cent H_2SO_4 a day with a conversion efficiency of 98 per cent the plant comprises sulphur melting and settling pits, sulphur burner, hot gas filter, waste heat boiler, converter, economiser, atmospheric gas cooler, drying and absorber towers, acid cooling and



Aerial view of Fisons' Factory at Immingham



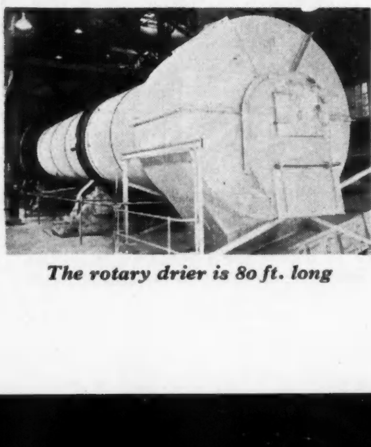
General view of the sulphuric acid plant

dilution system, together with the necessary pumps and ancillaries and a 440 h.p. blower. All the instruments are centralised in a small control room, and the plant is operated by two men per shift. The product is stored at 94 per cent strength in four large tanks having a total capacity of 6,000 tons of 100 per cent acid.

Phosphate rock is ground by four Lopulco roller millers each grinding 12 tons per hour to a fineness of 80 per cent through a 100 mesh sieve. A Fuller Kinyon pneumatic system is used to convey the ground rock either to the single superphosphate, the phosphoric acid or the triple superphosphate plant.

No very great engineering problems were met with in designing the building for the single superphosphate plant, where ample light and ventilation is provided round the plant with its access ways and staircases. Acid and rock mixed in the form of a slurrie enter a Broadfield Den in the form of a thick paste. The Den has a rated capacity of 20-25 tons an hour. The gases evolved are vented to a scrubbing tower.

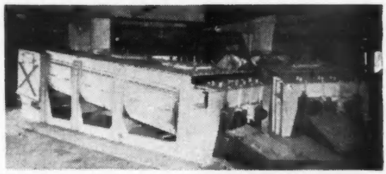
Construction of the phosphoric acid plant produced a number of problems. This is a steel-framed asbestos-clad building with horizontal continuous windows to give maximum light to the plant on the various floor levels. The upper floors are constructed in reinforced concrete and all floors are arranged to drain to special channels involving considerable complication in the reinforcement and the structural steel design.



The rotary drier is 80 ft. long

The plant is built to the design of the Dorr Co. Inc., and operates on the Dorr strong acid process. It is designed to treat 250 tons a day of ground rock and comprises reaction, filtration and evaporation sections.

Rock is treated with sulphuric acid in measured proportions in the reaction section which is in two halves, each having three premixer tanks and four agitator tanks in series. The liquor is re-circulated except for a proportion which is pumped to the filtration section. This contains five Landskrona belt filters for removal and washing of the precipitated gypsum, which is then re-slurried with water and pumped to a specially prepared disposal area of 146 acres.



Two blungers in superphosphate plant

Phosphoric acid from the filters has a strength of 32 per cent P_2O_5 and this is concentrated to 35 per cent P_2O_5 in the evaporation section, which comprises three cast lead single-effect steam-heated evaporators. Storage tanks are provided for both strengths of acid. Four wash towers deal with gases evolved by the reaction.

The seven-storied building housing the Dorr triple superphosphate plant is as high as Tower Bridge and involved a number of problems in design, such as the accommodation of a rotary drier in a fairly restricted space and consideration of its heat effect upon the structural steel.

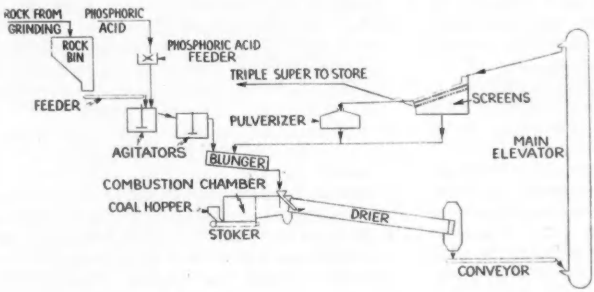
A capacity of 230 tons a day of triple superphosphate in granular form is attained by this plant. This requires the treatment of 100 tons a day of phosphate rock with phosphoric acid in lead-lined reaction tanks. A considerable proportion of recycled fine product is then added and the mass

thoroughly kneaded in a large paddle-mixer known as a Blunger, two of which are installed.

The mix is then dried in a rotary drier, after which it passes to the screening section where the desired size fraction of granular product is removed and taken by conveyor belt to the store. Oversize is crushed and recycled along with the undersize. Evolved gases are scrubbed in wash towers.

Near the superphosphate and salts store a granulating plant is

Above: Store for single and triple superphosphate in bulk



Left: Flow diagram of the triple superphosphate plant

installed for the production of compound fertilisers. The mixture is prepared by mixing weighed quantities of the constituents and wetting them to the right consistency in a rotary conditioner. The plant has a nominal capacity of 12½ tons an hour.

There are a variety of different storage buildings constructed for the reception of the raw materials and the finished products. Relevant costs are, of course, dependent on the quantity stored and the method of extraction employed. Storage capacities (in thousands of tons) are: sulphur, eight; sulphuric acid, six; phosphate rock, 20; superphosphate (triple and single) 22; sulphate of ammonia, muriate of potash, 10; granular compound fertilisers 20.

The conveyor system in the factory is 2¼ miles in total length. Materials are discharged on to a conveyor belt installed in an enclosed gallery on two levels, the lower being for intake and the upper for outgoing. There are 68 different belts varying in width from 20-42 ins. and running at speeds varying from 15 to 230 ft. per minute. Each of the materials carried on the belts has different properties—abrasive, corrosive, hygroscopic or just sticky—which call for varying designs of the idlers and a variety of different treatments at delivery points.

Effluent is collected mainly from wash towers associated with the granulating plant, the triple superphosphate plant, the phosphoric acid plant and the single superphosphate plant in open reinforced concrete flumes 2 ft. wide, lined with special asphalt and faced with acid-resisting brickwork bedded in Rubex cement. The branch

flumes discharge into a main flume, similarly treated, which is 3 ft. wide and 1,500 ft. long falling towards the effluent pumphouse. Adjacent to the pumphouse is a Lea Recorder and in the pumphouse itself are housed three pumps operated by No-flote system of control.

Each pump is capable of handling 2,250 gals./min., any two of these normally being in use with the third as standby. The effluent is pumped through either one of two 24 in. diameter pipes, 3,000 ft. long to the effluent junction chamber situated on the river side of the main dock road. One of these 24 in. pipes was supplied in concrete lined with bitumen in view of the difficulties in obtaining cast iron. The other 24 in. pipe giving a 100 per cent standby line was supplied in cast iron rubber-lined pipe and was installed eight months after the concrete line was actually put into commission.

Two units for packing triple superphosphate or granular compounds into open-mouth sacks are rated to have a combined capacity of 1,000 one-cwt. bags per hour. They are built at first floor level to enable road and rail transport to be loaded by gravity chutes. Any oversize material is first screened out and disintegrated after which pre-weighed batches are automatically fed to the filling spouts.

Passing along a band conveyor the bags are closed by Union Special sewing machines, and then proceed either to the loading chutes or to the bagged material store. Provision is also made at the same location for bulk products from the triple and single superphosphate and compound stores to be loaded to railway trucks.

It was desired that the whole factory should be so planned as to use mechanisation to the greatest degree possible, and the whole factory can in fact be run with a total personnel of only 350 including office staff and shift workers.

Layout of the entire site has been so designed as to allow for a 50 per cent expansion. Fisons themselves, with experience of the fertiliser industry acquired over many years, evolved all the manufacturing process plant, but appointed as joint consulting engineers to carry out the engineering side of the project, were Sir Alexander Gibb & Partners, and Maunsell Posford & Pavry.

The factory was officially opened last week by Mr. Hervey Rhodes, Parliamentary Secretary to the Board of Trade.

More Sulphur Questions

M.P.s Seek Further Information

IN Parliament last week more questions were raised by Members concerning the sulphur supply position. Mr. Cyril Osborne (Lincoln South) asked the President of the Board of Trade, what steps he was taking to develop the pyrites resources in Wales; and what action he had taken on the correspondence sent to him on this matter over two weeks ago from Mr. M. Dandrick who owns mines near Aberystwyth.

Mr. Henry Rhodes, Parliamentary Secretary to the Board of Trade, said that from an analysis and test recently conducted of certain samples of pyrites from Wales, it was found that the carbonaceous content made them unsuitable for use on existing sulphuric acid plants. Further surveys were in hand. Mr. Dandrick was seen by officers of the Board of Trade on 30 March and he hoped that the inquiries, which he was informed would be made, would be completed shortly.

Mr. N. Macpherson (Dumfries) asked:

(1) In view of the shortage in this country, why the Board of Trade declined to purchase lots offered from sources other than the United States of America;

(2) what encouragement was being given to importers to obtain sulphur from every possible source;

(3) why purchases of sulphur made by manufacturers in this country from sources other than the United States of America were deducted from their B.O.T. allocation.

The Secretary for Overseas Trade, Mr. Bottomley, said that consumers of sulphur who wished to import privately any quantity they could secure to supplement the amount they were licensed to receive from the allocation made by the United States, had been told they were free to do so. Import licences were granted freely. All possible help was given to overcome any difficulties that arose in the completion of transactions, and any importers who were not themselves consumers, if they so desired, were put into touch with consumers.

No deduction was made by the Board of Trade in respect of any private purchase from the supply a consumer was licensed to receive from sulphur imported from the United States. The Board was not competing with private purchasers, but would consider any direct offer where the conditions of sale were reasonable.

The 1951 British Industries Fair

ON the other side of the Atlantic a clever publicity agent several years ago coined the phrase 'The Greatest Show on Earth' to advertise a circus. Through the years the British Industries Fair has come to be known as 'The Nation's Shop Window,' but we feel that the term 'The Greatest Trade Fair on Earth' would be even more appropriate, for surely none other can challenge its supremacy.

The exhibition, which first began during World War I, is being held at Earls Court and Olympia in London and Castle Bromwich in Birmingham, from 30 April until 11 May. At Castle Bromwich 1,300 exhibitors are in a building and there are also three acres in an outdoor section. Olympia has 300,000 square feet with more than 1,000 exhibitors of lighter industrial products, and Earls Court, with 260,000 square feet of space, is the largest unobstructed indoor arena in the world.

Birmingham Section

CHEMICAL engineering and the chemical and allied trades are again well represented in the engineering and hardware section of the British Industries Fair which opened at Castle Bromwich, Birmingham, last Monday.

The total space let is greater than last year although the number of exhibitors is slightly lower, there being some 16 fewer in the outdoor section.

Application of ceramic media to electrochemical processes absorbs a high proportion of the industry's output. 'Celloton' media in diaphragm plates 30 in. sq. with a wall thickness of three millimeters are shown by Aerox, Ltd., in its display. The main feature of the stand is a tank in the form of a column the top of which is nearly nine feet from floor level. Illuminated by indirect fluorescent tubes it will present a sound demonstration of the capacity of ceramic aerators at various pressures, a number of aerators and a selection of air pressures being under the control of a technical representative.

A variety of metal working chemicals is shown by Brent Chemical Products, Ltd. Its display includes water rinsable paint stripper, decarbonising fluids, rubber mould cleaners, emulsion cleaner, rust preventatives, and dewatering lacquers and oils.

Graphite electrodes for electric furnaces and graphite anodes for mercury arc rectifiers, graphite crucibles, stirrer rods, pyrometer sheaths, moulds and sintering boats are displayed by British Acheson Electrodes, Ltd.

British Labour Pumps

Pumps for handling all chemical food-processing solids, vacuum extraction, aerated solutions and other difficult application are the speciality of British Labour Pump Co., Ltd. Types of pump include self-priming packingless pumps, self-priming mechanical packing pumps, and multi-throated construction open impellers.

Chemical immersion black-process giving a protective and decorative gun-black finish which does not crack, peel or chip under any conditions is demonstrated by the Chemag Metal Colouring Co., Ltd. The process is not a dye nor, an electrical deposition, but an actual change in the surface of the metal, which does not, however, effect the size or the temper of the metal itself. The type of finish remains the same as before treatment, that is to say a matt surface results in a matt finish or a polished surface produces a polished finish. Treatment consists fundamentally of immersion in alkaline vats maintained at temperatures of 140° to 145°C.

Acid-proof stoneware still maintains its pre-eminence in those industries in which corrosion is one of the major problems. The central feature of Doulton & Co., Ltd.'s exhibit is a range of three different types of towers. These are shown in 12 in. and 24 in. diameter only, to economise space. The 12 in. absorption tower is in white chemical stoneware fited with an ejector of the same material operated by a small blower and motor. The 24 in. model is a plate column tower in 'Acitherm' stoneware for water-white hydrochloric acid plant, reactions in the plastic and petrochemical fission, and so on. A bubble tower is also shown in

white chemical stoneware and sections of it and the plate column tower have been cut to show, in the one, the detail of the dip pipe and cups, and in the other the plates in position. All three towers have conical flanged joints ground to give a vacuum-tight seal, and they are connected together for purposes of illustrating the method only, by conical flanged pipes. Other types of plant include a centrifugal pump impellor and other parts, as used in the Doulton-Pulsometer pump; an armoured screw-down valve; a small ball mill; and acid jugs. The company design and supply for the North American market especially Canada, but there is also increasing demand for its equipment in South Africa, India, South America, Australia and Denmark.

Fibreglass Insulation

Insulation in a variety of applications is one of the main features of fibreglass. Some of the problems it is claimed to solve include: maintaining warmth in a factory, keeping a driver's cabin sound-proof, an electric motor from burning out and a buried pipe free from corrosion. Fibreglass, Ltd., are demonstrating a number of uses in industry and medicine.

The range of gas burners available for the various industrial processes is demonstrated by the Gas Council with a special display of burner equipment, ranging from natural draught burners, both pre- and post-aerated, through medium to high pressure burners. Natural draught burners of the post-aerated type are used for the conversion or firing of central heating boilers, bakers' ovens, vat heating and other comparatively low temperature applications. The pre-aerated type are mainly used where direct contact with the flame is necessary, although also available and suitable for other furnace applications. Medium pressure burners give a fairly long flame, with a higher radiation factor than the higher pressure burners, and are suitable for several types of furnace, and for processes where a quicker rate of heat release is required than can be obtained with the natural draught burners. High pressure burners are specially suited to heat treatment and metal melting furnaces, and to certain furnaceless heating processes, as with the concentrated combustion burners. Two of the high pressure burners are for high pressure gas, including a burner developed to provide a high radiant emitter for special drying products. The exhibit is arranged so that each separate burner lights in turn, and has a mirror fitted which enables the observer to see the combustion conditions within the burner tunnels.

Pulverisers for grinding and drying coal, chalk, limestone and clay are being shown by Alfred Herbert, Ltd. Other exhibits include Hilger & Watts and Sigma instruments.

Salts, chemicals, anodes, polishing mops and compositions, finishing plant, materials for processing metals and non-metals, form the display of The Hockley Chemical Co.

An aluminium degreaser and cleaner which is neither caustic, inflammable nor toxic and is non-injurious to rubber is being demonstrated by technical experts of Jenolite, Ltd. New products being shown by this company for the first time include a decarbonising solution for removing carbon deposits from internal combustion engine valves, and an aluminium ornamental etchant which imparts an artistic finish to aluminium surfaces. Jenolite rust-remover and neutraliser is gaining increasing markets in the Dominions and the U.S.A.

Pumps for handling viscous, corrosive or abrasive fluids are displayed by Mono Pumps, Ltd., including the H. range for chemical products and stainless steel hygienic pumps for food and laboratores.

Morgan Cascade Cooler

A cascade cooler for cooling corrosive fluids forms the central feature among a number of interesting items shown by the Morgan Crucible Co., Ltd. The cooler is economical both in its first cost and in space requirements. Design allows for easy replacement of any tubes which may be carelessly fractured. It is emphasised that the life of graphite tubes is almost invariably determined by care in handling rather than chemical conditions. With cascade coolers the overall heat transfer coefficient from water through Carbinert to a liquid is not less than 65 B.Th.U./hr./sq. ft./°F.

Complete acid proofing organisation for all industries is the speciality of Prodorite, Ltd. Acid-resisting cements, mastics and compounds 'Prodor-glas' synthetic linings, plastic linings, coatings and fabrications and special industrial flooring and wall surfaces are all part of the firm's service. Like many others the company is affected by raw material shortages, particularly steel and sulphur. A substitute has however been found to reduce the use of sulphur, though the substitute process costs slightly more. The firm

is at present working on a big contract in South Wales.

Chemical plant including stainless clad jacketed mixers, evaporators, pressure vessels and centrifugal machines are being shown by Thompson Brothers (Bilston), Ltd. The company also has new designs in hot galvanising plant which incorporate thermostatic control and regulated fuel supply to give better coatings, savings on residuals and improved conditions for operators.

Woolgrease products in a complete series are well laid-out on the stand of the Westbrook Lanolin Co. Products comprise the 'Golden Dawn' range of B.P., technical and commercial lanoline; all ancillary woolgrease products; the 'Nicrolan' range and Government specification rust preventatives; industrial barrier creams.

Specialised castings and fabrication in steel for the chemical, oil, food and allied industries in ordinary and special irons and in mild and stainless steel are displayed by the Widnes Foundry & Engineering Co., Ltd.

Latest models of plastic injection moulding and extrusion machines are being demontrated by R. H. Windsor, Ltd. Injection machines range from one to 80 oz. Extrusion models are for plastics of all types including multi-screw machines up to 200 lb. per hour.

Glacial Acetic Acid Plant

One of the most intriguing exhibits among the metallurgical displays was shown by the London Aluminium Co., Ltd. This was a scale model of a plant to recover glacial acetic acid from an aqueous solution of dilute acetic acid. Another item of interest on this stand is a 9 ft. 4 in. paraboloid claimed to be the largest hand-operated spinning in existence. Spun from 12-gauge aluminium of 99 per cent purity, the spinning is formed on a chuck made from English elm.

Main applications of aluminium throughout its history from the formation of the British Aluminium Co., Ltd., in 1894 to the present day, form the background theme to this company's display.

A striking stand is that of the Birmingham Battery & Metal Co., Ltd., with columns of brass, copper and condenser tubes and a phosphor-bronze plate 95 per cent copper, 5 per cent tin measuring 12 ft. by 8 ft. by 1 in. thick and weighing 41 cwt.

Prevention of corrosion and wear and the reclamation of worn parts are being demonstrated by Fescol, Ltd., while aluminium bronze, manganese bronze, high conductivity alloys, Monel, Inconel, corrosion-resisting materials and chemical valves are being shown by Langley Alloys, Ltd.

Stainless steel industrial equipment including Glitsch 'Truss-type' trays for oil refineries and chemical plant and process equipment for food are the chief exhibits of Metal Propellors, Ltd. Degreasing and phosphate processes, chemical immersion finishes and equipment, together with tanks, vats, and welded fabrications are shown by Metal Processes Ltd.

The Olympia Section

OLYMPIA looks very gay under its canopy of pale blue shimmering gauze, hanging in long drapes from the roof down both sides, giving the effect of looking at a very distant mountain top. Indeed the height of the building makes the exhibition seem almost in the open air, and it is easy to lose oneself in the maze of clean-looking painted lathes sprouting up on all sides. Olympia is not, of course, confined to exhibiting chemicals, but this section of the Fair is undoubtedly of the greatest interest to the chemical industry.

On entering Olympia one of the first exhibits to strike the eye is that of Shell. The enormous range of products manufactured by this company is attractively represented by a great mass of hollow glass spheres, each filled with one particular oil, grease, DDT compound, solvent or wax, and arranged in myriad rows on a six-panel display wheel, surmounted by a modernistic design in struts. Opposite this is the model cracking plant that has been publicised, a working model superimposed on a photograph of the plant itself. This model clearly represents the movement of crude oil from a distillation unit into a cracking plant, through another fractionating unit and then to storage in vast spherical 'Hortenspheres'—spheres being best equipped to withstand the pressure.

I.C.I. is well represented at the Fair. The most interesting of their exhibits for many people is that of the drug 'Cronetal' which is said to cure alcoholism. I.C.I. (Pharmaceuticals) also venture upon less controversial ground by exhibiting a specimen of the relatively recent anti-malarial—Paludrine—as a white powder in a glass case.

The Distiller's Company are exhibiting a vast range of flavour concentrates, food colours, soft drink colours, cosmetic constituents, pharmacological products, essential oils, DDT oils and so on, but these were not actually on show at the time of viewing. Monsanto Chemicals have a number of conical flasks on show containing various products from rubber antioxidants. Altogether this firm shows a range of 200 chemicals made by them in Great Britain.

Celebrating Centenary

W. J. Bush & Co. are celebrating their centenary in appropriate fashion by reconstructing an entire room furnished in the style of 1851. None of the other exhibits they are showing were visible on Friday, but chairs and settees were there in abundance, adorning a gaily wall-papered study in pink and white striped paper, needing only the presence of a periwigged secretary using a quill pen to make the picture complete. Another firm to venture into the past are Howards & Sons. They are exhibiting posters depicting old methods of distilling fatty acids, a tan yard, and the various processes of striking, rolling, and splitting hides, as well as a container for quinine sulphate and somebody having a headache next to it—a sight only too frequent in certain advertisements of today.

Laporte Chemicals are showing a speciality exhibit concerning hydrogen peroxide. Besides demonstrating what this chemical does in the way of bleaching—examples of fur and textiles before (dirty) and after (clean) bleaching are shown in a glass case—a model peroxide manufacturing plant is also present. Not content with this the firm have built a small, ambitious model of a four-engined aircraft with four jet engines, designed to give a working demonstration of how a hydrogen peroxide jet-assisted take-off works. Fortunately for the London Fire Brigade jets issuing from the engines of the model are not the real thing, and the model taxies harmlessly along the runway without setting fire to anyone.

A little way past the Laporte Chemicals stand another branch of I.C.I. has a colossal plastic map of the world showing the agencies representing I.C.I. all over the world. Adorning the sea around the pink land masses were casual-looking green mermaids in various gymnastic poses, some doing the splits, some in other rather unexpected attitudes. Other exhibits are undoubtedly in place by now, but the plastic map surely reigns supreme.

The ABRAC stand is an unusually large one. They confine themselves to showing samples of their various products, with an accent on the edible varieties; but the fascinating glass bottles labelled with such tantalising names as 'banana essence,' 'apple-blossom,' 'pineapple essence' and suchlike do much to dispel any sense of uniformity. And the nose is interested long before the eyes. A. Boake, Roberts & Co., makes aromatic chemicals of all kinds; cosmetic species—possessing 'the rare quality of high, persistent, floral notes, combined with low volatility'—essential oils, terpeneless perfumes for soaps, floral perfumes and bases, food colour powders, and so on.

May & Baker have a large stand. They exhibit the multifarious uses of their products in a series of photographs on placards—in the home, the garden, at school and college, in the factory, on the farm and so forth. Also exhibited are a range of plastics for toys, lampshades and spectacles, and aromatic compounds for soap shampoos. The amateur photographer is well served by May & Baker and, of course, the world of medicine also. A very comprehensive stand, this, showing the wide nature of the firm's activities.

Quaternary Long-Chain Salts

Leda Chemicals are showing a range of their quaternary long-chain salts such as lauryl pyridinium chloride which are coming to the fore so much as high dilution disinfectants and for other purposes (see CHEMICAL AGE, 17 March, 1951). Brigge's Insecticides include large glass pots of green sulphur, anti-locust dust, Toxaphene, and other insect removers. Whiffen & Sons are showing a number of chemicals, but their stand was not quite ready at the time of viewing. An attractive exhibit, however, is a large hollow glass sphere with crystals of resublimed iodine on its inside surface.

Oxirane, Ltd., devote their stand to two main classes of products, glycol ethers on one side and ethanolamines on the other. The uses for these versatile latter substances cover detergents (monoethanolamines), flue gas absorption (diethanolamines) and

shampoos (triethanolamines), and the stand shows each of these uses diagrammatically. Lankro Chemicals have a small stand showing leather, plastics and textile chemicals, but this and a number of other stands in this region were more or less bare of anything except wood and sawdust when the writer went to see them.

Price's (Bromborough), Ltd., are going to show fatty acids, oleines, stearines and fatty alcohols as well as textile oils. The design of their stand and the way they are setting out each product in its box, one above the other, followed at its side by the uses, resembles nothing so much as a view of Covent Opera House as seen from the stage.

William Edge & Son exhibit a large range of their Drummer dyes, and in the instrument section Evans Electroselenium have their new absorptiometer on show.

Model HCl Plant

One of the most interesting exhibits in the Scientific Instrument section is that of the Thermal Syndicate. This comprises a complete model of a hydrochloric acid plant in fused silica, together with the largest cooling coil in the world made of this material, the only substance to stand up to the intense heat and corrosion involved in concentrated hydrochloric acid manufacture. The coil itself is 6 ft. 6 in. high, with a 3 in. bore and 10½ turns. It needed seven men to put it in place. Part of the apparatus—where the hydrogen and chlorine are combusted—has to stand up to temperatures which make it incandescent—and in other fields this substance is being used as the only practicable insulator for voltages of the order of 50,000-60,000 volts. The firm say that a market is developing for the material in Japan, for HCl manufacture, and that delivery is now delayed up to 10-12 months in consequence.

Glass Developments, Ltd. show on their stand a fractionating column actually working under total reflux for petrol labs. The adjustments possible on this model, they say, make it capable of refluxing totally or in part. They are also showing a gas analysis apparatus for gas and mining research and a range of spirit levels in tubes and circulars. Doulton & Co. are also represented by a stand, and show a number of their Kieselguhr and porcelain medicinal filter candles.

Earls Court Section

EARLS COURT is probably of less interest to the chemical industry than either Castle Bromwich or Olympia, but there is still plenty to see there. The plastics, textiles, pottery and glassware sections all contain exhibits that display the skill and ingenuity of the British chemist as well as of the British manufacturer and craftsman.

On the first floor there are 42 exhibitors of plastics, occupying some 9,500 square feet and demonstrating scores of different uses for plastic materials. All of the stands are attractive as well as educational and it is hard to single out any one for special mention. The largest and most comprehensive, however, is that of The British Plastics Federation which consists of a number of displays showing the activities of member firms such as Kenverne, Ltd.; I.C.I. (Plastics Division); British Resin Products, Ltd.; Universal Metal Products, Ltd. (Plastics Division); Runcolite, Ltd.; British Geon, Ltd.; British Moulded Plastics, Ltd.; J. Burns, Ltd.; Tenaplas, Ltd.; Bakelite, Ltd.; British Industrial Plastics, Ltd.; B.X. Plastics, Ltd.; De La Rue Extrusions, Ltd.; Crystalate, Ltd.; etc.

Among the products shown were celluloid cellulose acetate; casein; vinyl compounds; polyvinyl resins, latices, compounds and pastes; urea and melamine moulding powders; synthetic resin adhesives; corbinding resins; bitumen asbestos compounds; phenolic moulding materials; vulcanised fibre; ebonites, nitro-cellulose and acrylic moulding powders.

In the glassware section, James A. Jobling & Co., Ltd., had an attractive and interesting stand, part of which was used to display their 'Pyrex' brand laboratory, scientific and industrial glassware. In one window a selection of 'visible-flow' pipelines were on show and include a complete distillation apparatus was working. This was equipped with a Stabilag heating jacket, and a heating tape by Electrothermal Engineering, Ltd., was used on the fractionating column.

A small section of the stand belonging to the British Heat-Resisting Glass Co., Ltd., was devoted to heat-resisting glass for scientific apparatus.

In the china, earthenware and stoneware section, Johnson, Matthey & Co., Ltd., advertised liquid precious metal preparations, ceramic colours and transfers for decorating china, glass, etc.

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Metallurgical Section

The Corrosion of Aluminium

Low Temperature Station Carries Out Research

FOOD research under Government auspices in Britain is in the charge of the Food Investigation Organisation. Of the three main laboratories under this organisation, the Low Temperature Research Station for research in biochemistry and biophysics, at Cambridge, deals especially with work of a long-term nature. Among the subjects under investigation at this station is the corrosion of aluminium which, of course, is a problem of great importance to the food industries.

The research programme is being carried out in three stages. Work on the first phase started in 1933 and involved a thorough review of the literature to ascertain existing knowledge and provide a basis for future research.

The second stage of the programme was devoted to research on the corrosion of aluminium to fill some of the gaps revealed by this summary. This stage has also been completed, leaving the investigators free to concentrate on the third stage, namely, the application of their previous research in devising methods of protecting aluminium from corrosion by foods and beverages.

Amphoteric Properties

The following account of the work on corrosion was obtained from J. M. Bryan, who describes much of it as a straightforward study of the effect of various factors, such as the purity of the metal, temperature, *p*H, presence of salts, presence of oxygen, etc., on corrosion. Since aluminium possesses amphoteric properties, the investigators examined acid, neutral and alkaline conditions, although the last condition is only likely to be encountered in the use of detergents for cleaning equipment and utensils.

As is well known, aluminium owes its resistance to corrosion to a surface film of oxide or hydroxide. The protection 's greatest at *p*H 6-7, the region of minimum solubility, but a large measure of protection is also provided up to about *p*H 4 on the acid side and up to about *p*H 10 on the alkaline side of neutrality. Corrosion of aluminium, therefore, is largely a film problem and bears some relation to the physical and chemical properties of alumina. The relationship has limitations, however, because corrosion can occur not only through the film of oxide being dissolved by substances in solution, but also through its being penetrated and undermined by dissociated ions.

Three Courses of Action

In general, dissolved substances or their dissociated ions may act in one of three ways: (1) they may penetrate the film and react with Al to form insoluble products of corrosion which check or stifle further corrosion; (2) they may penetrate the film and allow corrosion to proceed on a local and restricted scale; or (3) they may dissolve the film and bring about general attack.

Corrosion is essentially an electrochemical process, and the anodic dissolution of aluminium $2Al \rightarrow 2Al^{+++} + 6\epsilon$ must be accompanied by some corresponding cathodic reaction to withdraw electrons (*e.g.*, $6H^{+} + 6\epsilon \rightarrow 3H_2$). The surface film of oxide hinders both these processes, and the rate of corrosion can be controlled either by the anodic or the cathodic reaction, whichever is slower, but the reaction may sometimes be under mixed control.

In the *p*H range in which the film is not readily dissolved, the nature of the anions is an important factor. In general, corrosion tends to be high when small anions are present, such as Cl^- ions, which can penetrate pores and weak places in the surface film. Large anions, such as tartrate and citrate ions, possess low penetrative power, and this explains why fruit juices have little action on aluminium in the cold. Hot fruit juices, however, dissolve the surface film and attack aluminium. This is in keeping with the known fact that hydroxy-organic acids form soluble complex salts with aluminium

hydroxide; the reaction, however, is slow at room temperature but rapidly increases with rise of temperature.

Accelerator or Inhibitor

The rôle of dissolved oxygen in corrosion is of special interest, because it can act as an accelerator or as an inhibitor of corrosion. Normally, it accelerates corrosion, cases where it acts as an inhibitor being seldom encountered under immersed conditions. This dual rôle is accounted for by assuming that dissolved oxygen can accelerate corrosion through its depolarising action at cathodic areas, or can retard corrosion through oxidation of the metal and the formation of a protective film. If an increase in the concentration of oxygen, or an oxidising substance, produces an increase in the rate of corrosion, then the action must be under cathodic control, or possibly mixed control, but if it has no effect on corrosion then it must be under anodic control.

The investigators at the Low Temperature Research Station have made use of this principle in devising an iodine test with an aqueous solution of iodine and potassium iodide which readily attacks exposed metallic aluminium, but has much less action on the oxide and on parts covered by oxide. The concentration of iodine is sufficiently strong to bring the corrosion under anodic control and thus to measure the degree of protection afforded by a surface film to penetration by anions.

The investigators have yet to check the validity of this test against other accepted methods for accelerating corrosion, but it has already proved useful in determining the relative efficiency of various etching solutions for dissolving the natural film of oxide on aluminium preparatory to plating it with other metals. This test is being applied in the third stage of the programme, namely, in studies on the protective properties of different types of films formed artificially on the surface of aluminium by chemical or electrochemical means.

While the function of oxygen in corrosion has been thoroughly investigated and is well-known, the question of the reaction of water with aluminium and the possible implications of this on corrosion by aqueous solutions has not received much attention. Thermodynamically it is possible for aluminium to react with water both in the absence of air and when air is present, and the energy changes involved are greater than those with other common metals.

The electrochemical equations representing this reaction, based on those given by Warner, are as follows:

Anodic areas:

$$2Al + 6OH^- \rightarrow 2Al(OH)_3 + 6\epsilon$$

Cathodic areas:

$$6H^+ + 6\epsilon \rightarrow 3H_2$$
$$\text{or } 6H_2O + 6\epsilon \rightarrow 6OH^- + 3H_2$$
$$\text{or } 3H_2O + 1\tfrac{1}{2}\,O_2 + 6\epsilon \rightarrow 6OH^-$$
$$6H_2O \rightarrow 6OH^- + 6H^+$$

The investigators have established that boiling water reacts with aluminium initially with the evolution of hydrogen and the formation of a protective film which soon checks further action. The action practically ceases after 6-8 hours in all cases, apart from a sample of super-pure Al with the surface untreated. Most unexpectedly, it continued indefinitely with this sample, but with another sample of super-pure Al of slightly different composition, the behaviour was similar to that of the first sample only for one day and thereafter conformed with that of the less pure metal. The second sample contained twice as much silicon as the first one. Since the inhibiting action of small amounts of silicate in solution is well-known, it was suspected that the continued corrosion of the first sample was due to the more complete elimination of silicon in the refinement of the metal.

Can be Prevented

Further support for this view was provided by a test which showed that the action of boiling water could be almost entirely prevented by the addition of 0.05 per cent or more of pure dialysed silica to the water.

The investigators determined the water-content of the film and found that heating the film to 150°C. eliminated 10.3 per cent of the water, leaving a residue of 15.5 per cent of firmly bound water which closely corresponded with that in the monohydrate (15 per cent). This particular temperature of heating was used because the thermal isobars of Fricke and Severin show that the monohydrate is stable at 150°C. and begins to lose water at slightly higher temperatures. The results obtained at the Low Temperature Research Station agree with the findings of Harrington and Nelson who, using electron-diffraction methods, observed that the pattern of the film corresponded to that of böhmite (α-$Al_2O_3.H_2O$).

Since the density of this monohydrate is known, the thickness of the film could be calculated from the weight increase. Assuming the thickness to be directly proportional to the increase in weight, it was estimated that the water-formed films on ordinary aluminium reach a maximum thickness of about 4×10^{-5} cm., a result which indicates that their thickness is intermediate between that of the natural air-formed film, which is about 10^{-6} cm., and anodic films, the thickness of which ranges from about 2.5×10^{-4}, to 2.5×10^{-3} cm.

Some indication of the protective properties of the water-formed film is given by the results of a corrosion test which showed that its resistance to hydrochloric acid is about four times that of the natural air-formed film. This reaction of water with aluminium probably plays a more important part in corrosion processes than is generally realised. Many workers have drawn attention to the readiness with which the surface film on aluminium is repaired through oxidation with air, but there is little reference to re-oxidation of Al by water and to the possible implications of this reaction in retarding or even preventing the corrosion by aqueous solutions in general. The action of boiling water on aluminium has been described in detail in *J.S.C.I.*, 1950, *69*, 169.

Becomes Reactive

Aluminium is very low in the electrochemical series, and when the surface film is removed it becomes almost as reactive as the alkali-earth metals. The more thoroughly the oxide film is removed, the more reactive the surface becomes. In a process recently developed at the Low Temperature Research Station for the direct plating of aluminium with other metals, the surface film of oxide is removed by dissolving it in hot acid. The metal needs to be washed between etching and plating, and if it is washed in water a new water-formed film is quickly produced. Like the original air-formed film, this is an obstacle to plating. Tests have shown that the longer the etched metal is allowed to remain in contact with water, the more it will adversely affect the adhesion of an electro-deposit, washing in hot water being more detrimental than a cold water wash. The investigators have tested various organic liquids as washing agents, but found none which would be satisfactory for commercial use. They then examined the possibility of adding some chemical to the water, either to prevent its action or to form a type of film which does not interfere with the plating process. Ultimately the difficulty was largely overcome by immersion for 15 seconds in HNO_3 (1 vol. : 4 vol.) before rinsing in water. The dip in nitric acid prevents subsequent reaction of the etched aluminium with water to generate hydrogen and form an undesirable type of film. This treatment allows a satisfactory adhesion of the coating to be obtained.

Quick Alternative Test

The investigators have found a simple and quick alternative test to the iodine for roughly assessing the decline in the reactivity of film-free aluminium during washing in various liquids. It consists merely of immersing the metal in a saturated solution of $CuSO_4$ and observing the rate and the amount of copper deposited. Film-free Al brings about rapid reduction and copious deposition of copper, whereas unetched Al is relatively inert. Visual observation of the amount of copper deposited and the rate of the reduction provides a rough index of the degree of re-oxidation of the Al by water or by an organic liquid.

It is hoped at a future date, by means of the iodine test, to compare the degree of protection given by the water-formed film with that of the air-formed film, at various stages of oxidation until the film ceases to grow. At the moment, however, the workers are fully engaged in improving their process for the direct plating of aluminium with nickel. The progress of this investigation was reviewed by J. M. Bryan, B.Sc., Ph.D., in a paper entitled 'The Etching of Aluminium for Direct Plating with other Metals', which was read before the Electrodepositors' Technical Society on 21 April, 1950.

'Ardil' Production

The latest news on 'Ardil,' the protein fibre now in production at Dumfries by I.C.I. Ltd. was given recently by Dr. David Traill, director, I.C.I. Ltd., and leader of the team responsible for the development. By the end of the year, he said, production should be at the rate of 20 million lbs. per annum. Cost would be in the region of 50 pence per lb., or one-fifth the price of wool.

American Chemical Notebook

ESTABLISHMENT of a $100,000 technical centre to carry out research on the development of improved foundry processes and techniques has recently been announced by the American Foundrymen's Society, Cleveland, Ohio. The centre is to be set up within the next two years in one of the principal mid-western cities of the U.S.A. More than $95,000 had already been raised through voluntary subscriptions of the society's members.

* * *

USING titanium hydride and moderate heat, scientists at the (U.S.) General Electric Company Research Laboratory at Schenectady, New York, have developed a process to solder glass to metal. The method can also be used to solder metal to ceramics and carbon, and is at present being tested for industrial applications. The glass and metal areas to be soldered are painted with a thin layer of titanium hydride, and solder is placed upon both painted areas. The parts are placed together and then heated under a vacuum. When the temperature reaches about 900°F., the titanium hydride decomposes. This causes the solder, which has already become molten, to adhere to the titanium-painted areas of both glass and metal. On cooling, a strong, tight bond is formed.

By using soft metal solders, it is possible to subject this glass-to-metal seal to rapid temperature changes without danger of cracking, despite the wide difference in temperature expansions between glass and metal. This is possible because the differences in movement are absorbed by the solder.

* * *

PERMANENT magnets made from non-critical materials have been developed by the Sylvania Electric Products Co. Inc., New York. The magnets, the result of intensive laboratory research, are now in the pilot plant production stage and are said to be suitable for commercial and military equipment. Previous efforts to conserve cobalt have resulted in the increased use of nickel, copper or other critical materials.

* * *

RECOVERY of manganese from steel-making waste has recently been the object of intensive research in the U.S.A. Some metallurgists believe that an estimated 440,000 tons of manganese a year could be found in economically recoverable open hearth slag. A miniature blast furnace 16 ft. high, has lately been placed in operation at Pittsburgh, Pennsylvania. It is intended to simulate conditions in a commercial structure and will attempt to recover the manganese slag from open hearth furnaces while removing undesirables such as phosphorus. If the theory being tested proves practical, a useful ferro alloy containing 80 per cent manganese will be produced.

* * *

REFRIGERATION equipment installed by B. S. Williams Co., Inc., Mount Vernon, New York, to cool cutting oils used in tool operations is expected to increase the output from metalworking automatic machines by 25 to 50 per cent. By maintaining a pre-determined temperature for a long period, errors and adjustments formerly due to varying temperature ranges are substantially reduced.

* * *

A NEW company for the development, production and marketing of titanium and titanium alloys has been formed by the P. R. Mallory & Company, Inc., of Indianapolis, Indiana, and the Sharon Steel Corporation, of Sharon, Pennsylvania. The new company, Mallory-Sharon Titanium Corporation, will offer a series of proprietary alloys to meet the demands of various industries. The P. R. Mallory Company has been active in titanium research for the last ten years and has carried out extensive development work since 1946 for the U.S. Navy's Bureau of Aeronautics. The Sharon company, a fully integrated steel producer, has the facilities for rolling and fabrication. One of the latter company's subsidiaries, Niles Rolling Mill Company, already has had experience in rolling large titanium sheets.

Steel in Peru

An agreement has been signed by the Corporacion Peruana del Santa and a French syndicate to instal an iron and steel plant at the port of Chimbote at an estimated cost of £3,333,333. The plant should be in operation within two years and is planned to produce 60,000 tons of steel per year.

Corrosion Processes & Their Prevention

AT a recent meeting of the London and South Eastern Counties Section of the Royal Institute of Chemistry, held at Brighton Technical College, with Dr. C. W. Herd in the chair, Dr. W. H. J. Vernon, O.B.E., the well-known authority on corrosion, read a paper on 'Corrosion Processes and their Prevention.' Following is a summary of Dr. Vernon's address :—

Statistics show the enormous importance of metallic corrosion in world economics at the present time, and there is much evidence of a growing recognition of its importance on the part of industry. Neglect of the subject at the academic level has probably been largely due (as pointed out on previous occasions by Dr. U. R. Evans and by the lecturer) to the name of corrosion, with its suggestion to many of a complete absence of aesthetic interest and a claim to investigation based only on economic necessity. The object of the present talk was primarily to emphasise that corrosion, covering as it does the whole range of reactions between metals and their non-metallic environments, presents in fact a field of the utmost attractiveness for study and research.

Process of Corrosion

The conception of corrosion as a reversion, or partial reversion, from the metastable condition of the metal to the stable condition of the mineral is now generally recognised. As to the nature of the processes involved in this reversion, the story is complex and fascinating. Certainly no less than in any other branch of science, and in contradistinction to the popular view, one is impressed by the order and regularity that one finds. The study of corrosion processes breaks into a number of cognate fields, *e.g.*, chemistry and physics, metallurgy and engineering, mineralogy and microbiology; but probably the best general preparation for such study is that afforded by the training of the physical chemist. Corrosion not only provides a fruitful ground for research, both of the fundamental and *ad hoc* type; it has the added incentive, in either case, of contributing to an ultimate object of national importance—*viz.* the conservation of Britain's metallic resources.

Corrosion reactions may be divided broadly into two groups—'metal-liquid (electrolytic) reactions' and 'metal-gas reactions' Processes that fall definitely within the first category are those of immersed corrosion and underground corrosion. Metal-gas reactions are represented typically by direct oxidation at ordinary and elevated temperatures and by certain tarnishing processes at ordinary temperatures. Atmospheric corrosion occupies an intermediate position, since both metal-liquid and metal-gas reactions enter into the process, which is pre-eminently the resultant of film formation and film breakdown. None of these divisions must be regarded as being rigid or exclusive.

Discussion

Many interesting details and examples of various aspects of corrosion were given before the lecture was concluded by reference to two methods of corrosion prevention which depend entirely upon the control of the corrosion mechanism, *viz.*, corrosion inhibitors and cathodic protection.

Dr. Herd opened the discussion with a question on sodium benzoate inhibitor which the lecturer said forms a film and acts as an anodic but 'safe' inhibitor. In answer to Mr. C. Hollingsworth, Dr. Vernon said that the addition of either chromate or benzoate to water, in concentration sufficient to prevent attack on steel during immersion, afforded very limited protection on subsequent exposure to air, contact with the solution containing the inhibitor being necessary for maintenance of the film. Messrs. E. Simpson and T. McLachlan asked questions about the effect of impurities in metals both from the viewpoint of inhibition of the electrolytic process by extreme purity and from the converse effect, *viz.*, alloying with elements capable of producing protective films, as in the production of stainless steels by addition of chromium and nickel to the metal; most progress had been made by the second approach. In reply to Mr. C. H. Upfold, the lecturer referred briefly to the mechanism

of corrosion fatigue, but added that a series of lectures would be required to deal with the subject. The final question before closure came from Mr. A. Pickles who asked if it is possible for desulphurican micro-organisms, which may thrive on organic fibres in a protective wrapping, to penetrate a non-aqueous system. Dr. Vernon confirmed that the organisms do make use of the decomposition products of organic matter so that organic fibre wrappings should be avoided. A good bituminous coating with inorganic reinforcement or filling is the best that can be advised, and there is no evidence that the bacteria can penetrate such material.

Zinc-Acid Reaction Fatal

GIVING evidence at an inquest on a chemical worker who died after having been overcome by arsine gas fumes while cleaning out a tank used in commercial arsenic production, an expert witness told the Romford Coroner on 25 April, that a chemical reaction between the arsenious acid in the sludge being cleaned out and the zinc on the galvanised bucket the worker was using produced the arsine gas.

Evidence of Dr. William S. M. Grieve, biochemist, was that the man had, by inhalation, drawn arsenic into his blood equal to the lowest concentration recorded in cases of taking arsenic by mouth or of having been administered it in murder cases.

Harold L. Haigh, chief chemist of Messrs. Hemingway & Co., Ltd., at whose Stratford, E., works the deceased was employed, said he knew that the Factory Act governing safety precautions in the process called for the use of rubber-lined or plastic buckets, and these were available at the premises. If he had known that the man was using a zinc galvanised bucket he would have stopped the practice.

The jury returned a verdict of death by misadventure on the man—Alfred E. Pawsey, aged 38—and said that the company should give more supervision in these cases.

A fellow worker said Pawsey entered the tank through a man-hole of 18 in. diameter and after ten to twelve minutes he climbed back and complained of giddiness.

Haigh, in further evidence, said that though the tank had been flushed out, there could have been sufficient arsenious acid in the sludge to react with the zinc of the bucket and produce fumes powerful enough to affect a man after ten minutes' close proximity to them. An extractor fan at the top of the tank drew off fumes but arsine gas was 2½ times heavier than air. Though he was not responsible for safety precautions, he would have made a recommendation for safety measures if he had thought there was any danger.

More U.S.A. Aluminium

AMERICAN aluminium plants will increase their production capacity by 1,000,000,000 lb. by 1953, industry representatives announce. Present capacity is 1,454,150,000 lb. a year. Since the manufacture of aluminium began in the United States 63 years ago, the industry has grown from a single company with a capital of $20,000 to a $1,000,000,000 enterprise. For many years the Aluminium Company of America (Alcoa) was the nation's only producer of primary aluminium. It is still the largest producer, but there are now four others in the field. Abundant and inexpensive electricity has fostered the industry's growth. Ten to 12 kilowatt hours of electricity are required to produce 1 lb. of aluminium. Some of the plants now being planned will be built in the south-western part of the United States near natural gas fields which can supply them with power at small cost.

Alcoa plans to expand its production facilities by 398,000,000 lb. (179,100,00 kilograms) for a 50 per cent increase over its present capacity. Reynolds Metals Company, another producer, will be able to manufacture 528,000,000 lb. of primary aluminium a year when its proposed new facilities are operating. Kaiser Aluminium Company will add 200,000,000 lb. a year to its capacity. The Harvey Machine Company, a new producer, is planning to increase its annual capacity by 144,000,000 lb. Another new firm, the Apex Smelting Company, will be able to increase its annual output by 108,000,000 lb. when it completes its proposed new plant.

The industry receives most of its supply of bauxite, the ore from which aluminium is made, from other countries. In 1949, the latest year for which figures are available, Surinam, Indonesia, and British Guiana furnished the bulk of the 1,380,728 tons of bauxite imported by U.S. aluminium producers. In the same year U.S. bauxite mines provided 907,645 tons.

The Determination of Tungsten

Part III*—Titrimetric Methods

THE few methods available for the titrimetric determination of tungsten have not so far come into common use, due possibly to the fact that, like the inorganic precipitation methods, they are by no means selective; furthermore, considerable doubts exist as to their accuracy.

Titration with Benzidine

In the precipitation of benzidine tungstate from neutral solution, pronounced hydrolytic adsorption of excess reagents occurs on the precipitate when all the tungsten has been removed from solution. This, in turn causes a marked change in *p*H, which Campo and Sierra[56] used as the basis of a titrimetric method for the determination of tungsten in steels. The tungstate solution is titrated with a solution of benzidine hydrochloride using methyl red as indicator; the first drop of reagent in excess causes the indicator to change colour. The reagent must be standardised against a standard solution of sodium tungstate.

In an earlier paper, Kancher[57] precipitated tungsten with benzidine, hydrolysed the benzidine tungstate to tungstic acid and titrated the latter with standard alkali. He claimed that the method gave results to within 0.1 per cent of theoretical, but Mokeev[58] found that the results varied according to the tungsten content of the sample, unsatisfactory results being obtained with samples containing less than 0.2 g. of tungsten.

Reduction Methods

It is well-known that many metal cations and anions can be reduced to a lower valency state by treatment with amalgams; the reduced solutions may then be determined titrimetrically with potassium dichromate or some such oxidant. Tungsten, however, is polyvalent and it is difficult to stop the reduction at one definite valency stage, although Tananaev and Davidashvili[59] claimed that with tin amalgams hexavalent tungsten is quantitatively reduced to the trivalent stage between 10°C. and 70°C. in 2-8N sulphuric acid or 1-2N hydrochloric acid.

Flatt and Sommer[60] described the use of chromous chloride as reductant: solutions containing 50-200 mg. of tungsten as tungstate were treated with concentrated hydrochloric acid and atmospheric oxygen expelled by passing carbon dioxide through the solution for 10 minutes. The temperature was raised to 70°-90°C., and the solution titrated potentiometrically with chromous chloride. A distinct step in the potentiometric curve occurred when the valency of the tungsten fell from 6 to 5. Sulphuric acid must be absent. Mixtures of ferric iron and hexavalent tungsten showed one end-point on complete reduction of the ferric iron, and another when all the tungsten had been reduced to the quinquevalent stage. With copper and tungstate in strong hydrochloric acid solution, the first end-point corresponds to reduction of all the copper to the metal, and the second indicates reduction to quinquevalent tungsten. With chromate-tungstate solutions in strong hydrochloric acid, two end-points are obtained, between which complete reduction to quinquevalent tungsten occurs. Mixtures of molybdenum and tungsten give trouble; in this case, the first end-point corresponds to $Mo^6 \rightarrow Mo^5$, and the second to $Mo^5 \rightarrow Mo^3$ and $W^6 \rightarrow W^5$.

Chernikhov and Goryushina[61] examined the method of Flatt and Sommer, and confirmed that in hydrochloric acid, addition of reagent produced a gradual drop in potential, then a characteristic sharp rise at the equivalence point. They also confirmed that there was no reduction beyond the quinquevalent stage, and recommended that the reduced tungsten be titrated potentimetrically with potassium dichromate. The method is claimed to be suitable for ores of high tungsten content, the tungsten being held in solution by means of oxalic acid.

In a later paper[62] these workers examined the effect of various complex-forming acids on the reduction of tungsten by chromous ions. Tungsten as W_2O_5 reacts with several inorganic acids—H_3PO_4, H_3AsO_4, H_2SiO_3, H_2GeO_3, H_3BO_3, etc.—to form heteropoly compounds. Small quantities of phosphoric acid in hydrochloric acid decreased the potential change at the equivalence point, but did not interfere with the determination of tungsten. Silicic acid had no effect on the reduction, nor had citric, tartaric, oxalic, or

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* *Parts I & II—Gravimetric Methods—appeared in our issues of 7 April (page 527) and 21 April (page 601).*

formic acids. Decreasing the concentration of hydrochloric acid resulted in the formation of tungsten blue during the titration and poor results were obtained. In oxalic acid quantitative reduction of tungsten occurred and a large (hence, favourable) potential jump was obtained at the equivalence point. Molybdenum interfered, the sum of tungsten and molybdenum being obtained. Good results were obtained on a number of industrial materials.

Using a lead amalgam, Holth and Gray[63] reduced tungstic acid to trivalent tungsten in hydrochloric acid solution at 60°C. When the amalgam comes into contact with the hexavalent tungsten, a blue colour develops immediately which changes through violet, red, and yellow to deep yellow. The loss in colour indicates complete reduction to the trivalent stage. The amalgam is allowed to remain in contact with the solution for five more minutes, and the solution is then treated with excess of ferric alum solution. The ferrous iron produced is titrated with dichromate using sodium diphenylamine sulphonate as indicator. Tananaev and Davidashvili (*loc. cit.*) used tin amalgam in employing a similar procedure.

Titration with Lead Nitrate

Korobov[64] has determined tungsten titrimetrically with lead nitrate. The flocculent white precipitate of lead tungstate was found to have a sufficiently large adsorption surface to adsorb the dyestuff Diamine Light Red 6 B.S. at the end-point of the titration. The tungstate solution is heated to the boiling point, 5-6 drops of 0.1 per cent aqueous indicator added, and the solution of lead nitrate added dropwise, the solution being heated near the end-point. The titration error is claimed to be 0.1 per cent. Sodium and potassium chlorides and nitrates do not interfere, but alkali acetates and ammonium nitrate must be absent. The solution must be neutral.

Noda[65] has also examined the method, and has established the effects of temperature, boiling, time, and *p*H on the potentiometric titration of tungstate with lead nitrate.

Titration with Oxine

Merz[66] developed a titrimetric method for tungsten in which the neutral tungstate solution, contained in a standard volumetric flask, is treated with 0.4 per cent oxine solution, and kept at 80°C. for 30 minutes. The precipitate is filtered off and the excess oxine determined bromometrically. The results agreed to within 0.3 per cent with those obtained by the gravimetric oxine procedure.

3. Colorimetric Methods

Without doubt, the most important development in the analytical chemistry of tungsten has been the introduction of the reagent toluene-3,4-dithiol ('dithiol') for its colorimetric determination. Hamence[67] first noted that the compound gave a blue-green complex with tungsten and incorporated it in a quantitative scheme for the separation and determination of tungsten in foodstuffs. The blue-green colour obeys Beer's Law, but, unfortunately molybdenum forms a similar complex and must be removed or be absent. Bagshawe and Truman[68] modified the method for the determination of tungsten in steels in the presence of molybdenum, which latter they removed by first forming its complex and then extracting the complex with an organic solvent. The method is of such far-reaching importance that the working details may be described in full:

Add 30 ml. Spekker acid + 10 ml. concentrated HCl to 0.5 g. steel sample. Warm to dissolve and oxidise with concentrated HNO_3. Evaporate to fumes, cool, dilute to 100 ml. and mix well. Evaporate a 15 ml. aliquote to fumes, cool, and add 5 ml. of HCl (d = 1.06); warm until salts dissolve, and cool. Add 5 drops of a 10 per cent solution of $NH_2OH.H_2SO_4$ and 10 ml. of a 1 per cent solution of dithiol. After 15 minutes with some shaking, transfer to a 25 ml. tap funnel, using amyl acetate as transfer liquid. Shake, withdraw the lower acid layer and use it for the tungsten determination. Concentrate this carefully until all amyl acetate has volatilised, add a few drops of concentrated HNO_3 and evaporate to fumes. Clear up with HNO_3, rinse with a little water and re-fume to expel HNO_3 and water. Add 5 ml. of a 10 per cent solution of $SnCl_2$ in concentrated HCl and heat over boiling water for 10 minutes. Add 10 ml. of 1 per cent dithiol reagent and heat for 10 minutes. Shake from time to time. Transfer to a 25 ml. stoppered tap funnel, rinse three times with amyl acetate, draw off the acetate layer and again discard the acid layer. Dilute to exactly 50 ml. with amyl acetate and mix. Measure the absorption on the Spekker with 4 cm. cells and Ilford Spectrum Red No. 608 and Calorex H503 filters. Excellent results are obtained with steels containing 0.02-0.78 per cent of tungsten.

Vaughan and Whalley[69], who applied the

method to the determination of tungsten in ferrous alloys, have confirmed these findings.

Miller[70] has shown that rhenium also gives a green colour with dithiol and has stressed the importance of the reagent for detecting tungsten in association with large amounts of aluminium, beryllium, chromium, uranium, vanadium, zinc and phosphate. A preliminary reduction with stannous chloride eliminates the interference of these metals. Citric and oxalic acids reduce the sensitivity of the test, but hydrofluoric and other acids show little interference. Borate lowers the sensitivity and oxidants will oxidise the reagent. Iron (III), copper, arsenic (III), selenium, tellurium, gold, and platinum interfere.

Bickford, Jones and Keene[71] determined tungsten in food and drugs by the dithiol procedure. The material was wet-ashed, and, after dissolving the ash, ammonium sulphate was added to give a concentration of 4 mg./ml. and the *p*H was adjusted to 1.5-2.5. Dithiol reagent was then added, the precipitate extracted with butyl acetate and the absorption of the green solution measured at 610-660 mμ. When molybdenum was present, it was determined first, by holding up the tungsten with citric acid; the tungsten was then determined in the residue. Large amounts of copper interfere.

Determination with Thiocyanate

The thiocyanate method, based on the formation of a yellow colour by the action of thiocyanate on reduced tungsten solutions, has been widely adopted. The most common reductant is stannous chloride, but titanous chloride has been recommended by Kinard[72], because its reaction is more rapid, while Bogdachenko and Sapir[73] preferred titanous sulphate. Iron, calcium, magnesium, aluminium, phosphate and sulphate do not interfere. The interference of nickel, cobalt, chromium and vanadium is negligible when present in small amounts. Arsenic and oxidants should be absent. Molybdenum also forms a yellow colour, but its interference is negligible when less than 0.6 mg. is present.

Sandell[74] has applied the method to the determination of tungsten in silicate rocks. The sample is decomposed with hydrofluoric, sulphuric and nitric acids, and a double precipitation of iron, titanium and other metals performed with sodium hydroxide. The filtrate is treated with tartaric acid and acidified. Molybdenum is precipitated with hydrogen sulphide using antimonic sulphide as collector. The tungsten is determined in the filtrate from the separation by addition of thiocyanate, hydrochloric acid and stannous chloride, followed by ether extraction of the yellow thiocyanate complex. The colour is compared with standards treated similarly.

Considerable loss of tungsten occurs through entrainment on the iron and titanium precipitates in the hydroxide separation of these metals. Results obtained by the thiocyanate-titanous chloride method are greatly affected by the amount of titanous chloride used in the reduction. The solution must be strongly acid, and this leads to evolution of hydrochloric acid in the colorimeter. The advantages of the method, however, outweigh its disadvantages. Thus, it is more rapid than the stannous chloride reduction method.

Emery and Curtis[75] determined tungsten in high speed tool steels using titanous chloride and ammonium thiocyanate as reductant and colour developer respectively. Their method is briefly as follows:

Weigh 2 g. alloy into a 400 ml. flask, add acid mixture (12 ml. H_2SO_4, 60 ml. H_3PO_4, 100 ml. H_2O) and simmer until the reaction ceases. Add cautiously 10 ml. 5N HNO_3, boil, fume and cool. Dilute, boil 3-5 minutes, cool, and make up to 200 ml. Take 15 ml. of this solution, make up to 100 ml. with acid mixture, mix and take 10 ml. of this last solution. Add 10 ml. concentrated HCl, mix and cool. Add 10 ml. 10 per cent NH_4CNS solution, mix and add a volume of $TiCl_3$ solution equivalent to 20 mg. Fe and make up to 50 ml. with 50 per cent HCl. Mix and, after 15 minutes, determine the absorption of the yellow-green colour on the Spekker absorptiometer using the mercury vapour lamp, Ilford Spectrum Violet filter No. 601 and H503 heat absorbing filter, with a water setting of 1.2.

More recently Wood[76] has described a simplified rapid procedure for the determination of tungsten in alloy steels using sodium thiocyanate and stannous chloride as reagents. Accurate results are reported.

Popov[77] has used the thiocyanate method with success in the determination of tungsten in ores. For best results he proposes that tungstic oxide concentrations of up to 0.1-0.2 per cent be determined by an acid procedure, an acid-alkaline method being satisfactory for all tungsten concentrations.

Gentry and Sherrington[78] have modified the thiocyanate procedure somewhat. They reduce the tungsten to a definite valency stage with tin amalgam (Hg heated with an excess of Sn in the presence of dilute HCl) prior to the formation of the characteristic thiocyanate compound. Molybdenum, vanadium and columbium interfere. The method may be applied to the analysis of lamp filaments, steels, alloys, etc.

Benzidine and o-Dianisidine

Ubeda and his co-workers[79] have proposed two new methods for the colorimetric determination of tungsten in wolframite. The two reagents are benzidine and *o*-dianisidine respectively, which form insoluble precipitates with tungstate. The precipitates are dissolved in acid, diazotised and coupled with phenol, the colour intensity being measured on a colorimeter. Good results are claimed, although the precipitation has to be carried out in neutral or weakly acid solution.

Determination with Hydroquinone

Defosqz[80] first observed that hydroquinone gave a red colour with tungstic acid in concentrated sulphuric acid, and Heyre[81] applied this reaction to the colorimetric determination of tungsten. The presence of moisture, however, causes a reduction in colour intensity, and great care must be taken to ensure absolutely anhydrous conditions during the determination. Iron (III), titanium, molybdenum, chromate and nitrate interfere, but nickel, alkali metals and phosphate may be present. Molybdenum gives a colour similar to tungsten. Bogatzki[82] and Klinger *et al.*[83] have used hydroquinone for determining tungsten in steels, the interference of iron and molybdenum being prevented by addition of a reductant. Bogatzki's procedure has also been applied to high speed steels containing chromium. Recently, the method has been re-examined by Johnson[84], who found the accuracy comparable to the usual gravimetric methods. The colour intensity is relatively permanent and may be measured almost immediately after development. The reductants employed by Johnson were stannous chloride and tin in concentrated hydrochloric acid. Columbium interfered, but tantalum could be present.

Determination with Rhodamine B

Rhodamine B gives a violet colour to solutions of tungstate in hydrochloric acid and Heyre[81] used the reagent for determining small amounts of tungsten. Unfortunately, molybdenum reacts in the same way, but the colour produced is much less intense. For this reason, when dealing with trace amounts of both metals, the rhodamine B reagent is preferred to hydroquinone. The colour is stable for one hour only and free hydrochloric acid in large amounts interferes.

Determination with Copper Sulphate

The colorimetric determination of tungsten based on the measurement of the colour of copper tungstate was proposed by Shemyakin *et al.*[85]. The copper tungstate was precipitated in neutral solution and the solution heated to 75°C, for half-an-hour to ensure complete precipitation. The precipitate was washed with 80 per cent ethanol and dissolved in 28 per cent hydrochloric acid. The colour was compared with that of a standard copper solution. The method was re-examined and slightly modified by Sysaev[86], who heated both the copper and tungstate solutions to 70°C. before precipitating, and filtered the dissolved precipitate directly into the colorimeter vessel. The method is recommended as being suitable for concentrations of tungsten between 2.8×10^{-4} and 2.8×10^{-5} g./ml. Although the method is simple and requires inexpensive reagents, it should be noted, however, that copper tungstate is appreciable soluble in excess of copper sulphate and a factor must be introduced. Sysaev prefers a factor of 0.7 instead of the original 0.9.

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Aluminium Development Association

Progress and Prospects Outlined at A.G.M.

THE annual general meeting of the Aluminium Development Association was held on 20 April, when Mr. Austyn Reynolds was elected president for the year 1951/52. Mr. Reynolds is a director of Tube Investments, Ltd., and deputy chairman of T.I. Aluminium, Ltd., and associated aluminium companies. He has served on the A.D.A. Council for six years and was vice-president of the Association during 1950/51.

The new vice-president is Mr. H. G. Herrington (High Duty Alloys, Ltd.). Mr. F. G. Woollard, M.B.E., was re-elected chairman of the executive committee.

At the meeting, the retiring president, Mr. Edward Player, introduced the annual report by drawing particular attention to those activities linked with long-term development of aluminium in the major engineering industries.

During 1950 progress was recorded by the association in many of its activities (said Mr. Player), particular attention being directed towards the long-term development of aluminium in the major engineering industries. The year began under a cloud of uncertainty following the increased cost of aluminium as a result of devaluation in 1949, and ended in even more uncertainty owing to the increasingly difficult metal supply position.

Interest Increased

During the year, however, owing to the shortage of other non-ferrous metals coupled with their high cost, and the increasing difficulties of obtaining steel, the interest of metal users in aluminium increased substantially. Although in many cases inquiries at the outset were based on the assumed availability of aluminium, or its lower cost, this initial interest often led to a better realisation of the value of the inherent characteristics of aluminium; and this interest should be turned to good account by the industry when metal is again available for large-scale developments.

Discussions on policy during the year indicated that the course pursued during the first five years of the association's existence has been generally on the right lines, but there has been some re-adjustment in the relative importance of ultimate and immediate objectives. Certain changes in the organisation of committees was foreshadowed and ultimately the number of committees, and hence the number of meetings, should be reduced. Two new sub-committees were set up during the year, the total number of committee meetings remaining at 42.

Research Continued

Research continued into basic problems in shipbuilding, structural engineering and methods of joining, and the results of these investigations which have become available during the year, plus the association's long-term development work, will undoubtedly benefit future applications. Standardisation has again formed an important part of the association's work and the year has seen the virtual completion of the new series of British Standards for Aluminium for general engineering purposes, as well as several standards for end-products.

The many details set out in the annual report indicate the wide range of activities handled by the staff both directly and in association with the technical committees.

The information services of the association—that is to say, inquiry work, technical memoranda, publications and educational activities—all show progress as the following figures indicate:

11 new publications were issued and a total of more than 177,000 copies were despatched to a mailing list of over 14,000.

67 Association publications are now available as well as a total of 71 technical memoranda, some of which are confidential to members.

Over 3,600 inquiries were answered and the library made 985 loans.

It is hoped that the feeling of frustration and disappointment due to metal shortage will not be of long duration, for there is little doubt that the policy and programmes pursued by the association during 1950 have materially increased the stature of the association and engendered goodwill.

Mr. Player said he felt more convinced than ever of the promising future of the aluminium industry, and equally convinced

of the importance of the excellent work that this association is doing. In due course, when the present shortages of material had been overcome, he felt certain that members would be able to dispose of all the aluminium which the ingot producers were able to supply. A great many new uses undreamed of ten years ago were now accepted as standard applications and undoubtedly hundreds of fresh uses awaited development in the future.

Preventing Corrosion

Advantages of Electrodeposition

PREVENTION of corrosion and wear of plant equipment, often operating under severe conditions as regards attack by acids and similar substances are of great importance to the chemical and allied industries. It is being increasingly recognised that one of the most successful solutions of the problem is electrodeposition of metals, and for example both nickel and chromium possess a high degree of resistance to a wide range of corrosive agents.

Corrosive effect of solutions is influenced by a number of different factors, including particularly concentration, temperature, and degree of aeration. Fescol, Ltd., London, have carried out a great deal of investigation on electrodeposition in every branch of industry, and are engaged in continual research and development of fresh applications.

The principle of the Fescol process is based on the efficient adhesion or interlocking of the deposited material to the basis metal, this blending (it is said) being so effective that it is impossible to dissociate the materials. As the work is carried out cold, any fear of distortion through heating of the component or part to be treated is eliminated, and there is given a deposit uniform in hardness and texture throughout.

To mention a few examples, both nickel and chromium possess good resistance to formic acid and lactic acid, while citric acid has no action on chromium and little or no action on nickel under most conditions. Stearic acid has no attack on chromium, and only slight attack on nickel in the case of hot acid. In both cases also sulphuric acid has little effect at low temperatures and concentrations.

As regards specific industrial applications, both nickel and chromium are widely used. Nickel, for example, is entirely non-toxic and is therefore particularly suitable for vessels employed in the preparation of all kinds of food products. The vessels, whether of copper, cast iron or steel, can have the surfaces in contact with the food protected by a deposit of nickel. In the same way boiling pans and mixing vessels are protected by interior deposits of nickel.

Other interesting applications are beer and wines, and fruit juices and beet sugar juice.

In soap-making, staining of the product due to oxidation of the vessels used in its preparation, can be prevented by deposits of nickel or chromium. Moulds employed for producing soap tablets when deposited in chromium are found to increase the production rate by at least 8 per cent and to reduce the cleaning time to a minimum, while cooling plates are protected against corrosion by deposition of nickel on the faces. In the case of soap plodders a combination of the two metals gives highly satisfactory results, the interior being deposited with nickel and the faces of the worm in chromium.

For the treatment of new plant and equipment, and for the building up or restoring of worn parts or components, 'Fescol-'ising is equally suitable. Another advantage is that when wear does eventually take place the process can be repeated, thus, it is claimed, prolonging the working life of machinery almost indefinitely.

Synthetic Fibres on Show

The Manchester textile manufacturers, Fothergill & Harvey, Ltd., last week opened a new showroom in London in which their synthetic fabrics are prominently displayed. Their well-known products 'Tygan' and 'Tyglas' were shown in many different forms and they caused considerable favourable comment.

'Tygan' is made from 'Saran' yarn manufactured exclusively by B. X. Plastics Ltd., from polyvinylidene chloride supplied by the Dow Chemical Co., of the United States. It is used for upholstery, filters and for making flyscreen. 'Tyglas' is a woven glass fabric and is used for electrical insulation, filtering and laminating. The raw material is supplied to Fothergill & Harvey by Fibreglass Ltd.

Publications & Announcements

RAW MATERIALS and their shortages lend particular interest to the report on the chemical industry now issued by the Purchasing Officers' Association as No. 17 in its series of Raw Material Surveys. The booklet, entitled 'Chemicals and Fertilisers,' by F. Richard King, is an excellent attempt to set out lucidly factual information on a highly complex subject. Acknowledgments are made to I.C.I. for extracts from its magazine and to the A.B.C.M. for permission to reproduce the chart of the principal products of the British chemical industry from its 'Report on the Chemical Industry, 1949.' Another booklet in the series now available is 'Raw Materials of the Refractories Industry' (No. 18), by R. J. Mitchell, M.P.O.A. (The Morgan Crucible Co., Ltd.) in which the author explains what refractories are, describes their main functions, and shows how they may be broadly classified into three main groups—acid, intermediate and basic.

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EDUCATION is one of the main features of the 40th annual report, 1950-51, of the British Electrical and Allied Manufacturers' Association (Inc.) recently available. The Education committee did valuable work in connection with FBI Scholarship Scheme, the Athlone Fellowships, recommendations to the National Advisory Council on Higher Technological Education, call-up of apprentices and students, and post-graduate training. BEAMA also presented Cambridge University with a cheque of £71,000 to endow in perpetuity the Chair of Electrical Engineering. The Technical committee's activities increased during the year and a good deal of time was spent on international work and on consideration of draft specifications from the BSI and Standards organisations in the Commonwealth.

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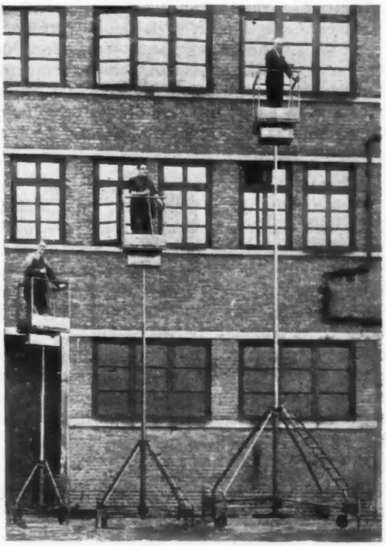
INDUSTRIAL uses of high vacuum and the striking way in which in recent years laboratory techniques for rapid evacuation have been transferred to various technical and industrial processes are described by Professor E. N. da C. Andrade in the April 'Survey of the Progress of Science' published by *The Times*. Other articles include: 'Science in the Iron and Steel Industry' by Sir Charles Goodeve.

NOW in production at the Mechanical Developments Division of William Moss & Sons, Ltd., are alternative 'Beanstalks' which are suitable for a great number of industries and trades. These alternative 'Beanstalks' are: 30 ft. working height model, Baby model with 18 ft. working height, Trailer Model which has a working height of 25 ft. and is quickly detachable for use inside buildings, and model with umbrella framework for conveying in small lifts. All these models can be power operated if required, and they are now found in use in a host of industries and factories including engineering and chemical works. The 'Beanstalk' may be pushed through doors 6 ft. 6 in. high by 2 ft. 6 in. wide. Guard rails are lowered and framework scissored to allow free movement through doors and narrow gangways. The working platform is raised on a triple telescopic ram by means of hydraulic power. Manual reciprocation of the pump lever attached to the platform operates powerful hydraulic pump contained in the oil reservoir.



Three 'Beanstalk' models

OVERSEAS

To Extract Uranium

The West Driefontein Gold Mining Co., Ltd., and the Stilfontein Gold Mining Co., Ltd., announce that by arrangement with the Atomic Energy Board of South Africa, they will each erect a plant for the extraction of uranium from the residue slimes of their gold production plants. It is estimated that their plants will be ready for operation during 1953, and the contract with the Board will be for the sale of uranium over a period of ten years from the time the plant is in full production.

Fight Against Locusts

The serious locust plague—the worst recorded for 80 years—now threatening the crops of Persia has brought a rapid response from British as well as American scientists. The U.S. State Department has arranged for a fleet of light aircraft to start immediate spraying operations using the latest insecticides. Meanwhile, Dr. John Hardy, 40-year old London entomologist, who directs Shell's Experimental Farm at Woodstock (Kent), has also flown to the scene as an observer. Dr. Hardy's particular province is to watch the performance 'in action' of the new insecticide Aldrin, which, although already used experimentally by Shell on a world-wide basis, has not before been used for spraying the species of locust now plaguing Persia.

Aluminium Plant for Venezuela

The Aluminium Company of Canada, Ltd., and the Venezuelan Government have started negotiations looking toward the construction of an aluminium plant in the Orinico region. The plant would use bauxite from the Guianas with power for its operations supplied by a 250-kilowatt plant on the Caroni River now being studied. The power plant would require a loan of about £17,000,000 to start, and it is understood that the aluminium company will help to obtain this financing.

U.S. Carbide Plant

The construction of a new plant which will significantly increase the United States' supply of calcium carbide, which is vital to defence production, is due to begin at Calvert City, Kentucky, in July. The plant will have an initial capacity of 142,500 tons annually. Calcium carbide is the primary source of fuel used in oxy-acetylene welding and cutting processes. The plant will be owned by the Air Reduction Company. Its two electric furnaces, the first of their kind to be used in the U.S. for production of calcium carbide, were designed by a Norwegian firm. The plant will consume more than 1,000,000 kilowatt hours of electricity daily or enough to meet the normal requirements of a city of 250,000 inhabitants.

Brazilian Steel Plant

The company which constructed the Volta Redonda steel plant in Brazil is reported to have obtained the contract for constructing the steel works for the Paz de Rio enterprise at a cost of $45,000,000. The plant will have a capacity of 150,000 tons per annum and should be installed by the middle of 1953. Equipment to the value of $20,000,000 has been provided from French sources. The Empresa Colombiana de Petróleos, also, is planning the construction of an additional oil refinery of 20,000 barrels per month capacity costing about 24 million pesos, which will be advanced by the International Petroleum Company.

Neoprene Airdry Coating

Neoprene, the synthetic rubber made by Du Pont, Washington, Del., can now be applied as an air-dry protective coating for industrial maintenance work on structural steel, concrete, wood and exterior surfaces of tanks and equipment. It is applied by brush or spray gun in a single coat. Outstanding properties are those which distinguish neoprene from natural and other synthetic rubbers—exceptional resistance to oil, grease and chemicals; and resistance to age-cracking by sunlight, weather and ozone. It also possesses the characteristic properties of any rubber product—resilience, elasticity, a high order of abrasion-resistance, and non-cracking properties. The new material is produced by Gates Engineering Company of Wilmington, Delaware, and has been named Gaco Neoplene Maintenance Coating. An outstanding feature of the 'airdry' coating is the fact that it develops its desirable physical properties without the benefit of heat.

R.I.C. Officers Elected

Annual General Meeting Held

THE seventy-third annual general meeting of the Royal Institute of Chemistry was held in the Lecture Theatre of the Institution of Electrical Engineers, London, W.C.2, on Friday, 27 April. Professor J. W. Cook, F.R.S., president, occupied the chair.

In presenting the annual statement of accounts, the hon. treasurer, Dr. D. W. Kent-Jones, referred to the notable increases in expenditure which had been incurred during the past two years in order to make much better provision for the activities of local sections, and for the Institute's publications. The improvements in these important services had been widely welcomed, but a time had now been reached when further expansion would need to be held up, he hoped temporarily, through financial stringency. He believed, however, that unless prices rose quite abnormally it would be possible to get near to balancing the budget in 1951, and to do so completely in 1952, without lowering the high standard of activities and services achieved in recent years. Dr. Kent-Jones also referred to the extensive alterations to the Institute's premises at 30 Russell Square, which would provide for additional offices and committee rooms, as well as for converting the library into a Members' Room, in which members could meet one another in pleasant surroundings.

Satisfaction Expressed

In presenting the report of the Council for 1950, the chairman expressed satisfaction at the completion of the task of revising the by-laws, following the grant of the new Royal Charter in 1949. Apart from simplifying procedure in many directions and removing some inconsistencies, the new by-laws allow of the election of up to 20 hon. fellows and for the establishment of an Ethical Practices Committee to advise the Council on questions of professional conduct. Since the end of 1950, the corporate membership of the Institute had passed the 12,000 mark, and one more local section had been constituted, bringing the total to 33. The chairman concluded by expressing his indebtedness to the other honorary officers and members of the Council for the support they had given him, and to the salaried officers and staff of the Institute for their work.

The report of the scrutineers on the ballot for the election of officers, general members of the Council and censors was received, and the chairman then declared elected the fellows whose names appear below. Under the new by-laws the number of general members of the Council has been reduced from 27 to 21, and the number of district members of Council increased by resolution of the Council from 16 to 18.

The New Officers

The result of the ballot was as follows :—

President : Mr. H. W. Cremer, C.B.E.

Vice-presidents : Dr. G. M. Bennett, C.B., F.R.S.; Professor Harold Burton ; Professor J. W. Cook, F.R.S. (immediate past-president, ex officio) ; Dr. W. M. Cumming, O.B.E.; Dr. C. W. Herd ; Professor W. H. Linnell ; Miss Mamie Olliver.

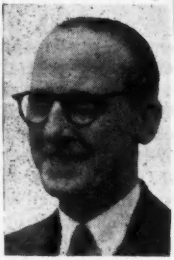
Hon. Treasurer : Dr. D. W. Kent-Jones.

Members of Council : Dr. W. R. Angus ; Mr. A. L. Bacharach ; Dr. Harry Baines ; Dr. Norman Booth ; Professor H. T. S. Britton ; Mr. F. C. Bullock ; Mr. R. R. Butler ; Mr. H. H. Campbell ; Dr. Thomas Caughey ; Professor C. W. Davies ; Dr. Charles Forrester, K-i-H ; Dr. A. T. Green, O.B.E.; Dr. J. G. A. Griffiths ; Sir William T Griffiths ; Dr. Frances M. Hamer ; Dr. H. H. Hodgson ; Dr. H. M. N. H. Irving ; Dr. Elias Isaacs ; Mr. A. R. Jamieson ; Sir Harry Jephcott; Mr. B. D. W. Luff; Dr. C. G. Lyons ; Dr. A. R. Martin ; Dr. R. A. Mott ; Dr. H. B. Nisbet ; Dr. Ridland Owens ; Mr. E. G. K. Pritchett ; Dr. G. R. Ramage ; Dr. E. H. Rodd ; Dr. Frank Roffey ; Mr. J. O. Samuel ; Dr. Charles Simons ; Mr. George Taylor, O.B.E.; Dr. P. F. R. Venables ; Mr. Harry Weatherall ; Professor T. S. Wheeler ; Dr. John Williams ; Dr. W. T. H. Williamson ; Mr. H. N. Wilson.

Censors : Professor Alexander Findlay, C.B.E.; Mr. G. Roche Lynch, O.B.E.; Sir Ian M. Heilbron, D.S.O., F.R.S.; Professor William Wardlaw, C.B.E.

PERSONAL

Reads of Liverpool announce the retirement of MR. LEONARD DODD, who has spent 44 years in their service. Mr. Dodd, who is well known in the drum and tin box industries, represented the company in London for 33 years, rejoining head office as general sales manager in 1944, a post which he held until April, 1950. For the past year Mr. Dodd has been been general sales adviser.



Mr. L. Dodd

Monsanto Chemical Company, St. Louis, American associates of Monsanto Chemicals, Limited, announces that DR. CHARLES ALLEN THOMAS was elected president of the company by the board of directors on 24 April, in succession to MR. WILLIAM M. RAND. Mr. Rand has been president since 1 October, 1945.

Dr. Thomas, who is 51, is one of America's outstanding industrial scientists, and has been associated with the United States atomic energy programme since its earliest days. Dr. Thomas is in charge of several Atomic Energy Commission projects now being carried out by Monsanto Chemical Company. He was chiefly responsible for persuading the Commission to co-operate with American private enterprise in the development of practical atomic power. Included among his earlier achievements was the development of tetra-ethyl lead for use in anti-knock motor fuels. He was one of the five co-authors of 'A Report on the International Control of Atomic Energy' and author of 'Anhydrous Aluminium Chloride in Organic Chemistry.'

Dr. Thomas is chairman of the U.S. Scientific Manpower Advisory Committee of the National Security Resources Board. He is a past president of the American Chemical Society and a past recipient of the Gold Medal of the American Institute of Chemists.

THE HON. WILLIAM BUCHAN, publicity officer to the Nobel Division I.C.I. since the end of the war, is to take up a new appointment in London with *Reader's Digest*.

At the annual general meeting of the London Chamber of Commerce which took place on 26 April, SQUADRON LEADER RICHARD LESLIE WINTERBURN, F.I.C.S., A.M.Inst.B.E., was elected to the Council of the Chamber. Squadron Leader Winterburn is a director of Standard Chemical & Pharmaceutical Corporation, Ltd., and managing director of Dermine, Ltd.

Next Week's Events

MONDAY 7 MAY

Society of Chemical Industry

London: School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. Annual General Meeting of the London Section at 6.30 p.m., followed by a paper: 'The Growing of Synthetic Crystals.'

TUESDAY 8 MAY

Chemical Engineering Group (SCI)

London: Burlington House, Piccadilly, W.1, 5.30 p.m. Messrs. G. T. Meiklejohn and R. C. Snell: 'Economic Reactor Design.'

WEDNESDAY 9 MAY

The Chemical Society

Newcastle: Chemistry Building, King's College, 5 p.m. Prof. R. B. Woodward: 'Some Recent Advances in the Chemistry of Natural Products.'

Food Group (SCI)

London: Burlington House, Piccadilly, W.1. Annual General Meeting at 6 p.m., followed by a lecture by Dr. W. F. J. Cuthbertson: 'Antibiotics in Nutrition.'

THURSDAY 10 MAY

The Chemical Society

London: The Royal Institution, Albemarle Street, W.1, 7.30 p.m. Prof. H. W. Melville: 'Transient Entities in Chemical Reactions.'

Incorporated Plant Engineers

Maidstone: Technical College, 7 p.m. Dr. Gyngel: 'Corrosion Theory and Practice.'

FRIDAY 11 MAY

The Chemical Society

Birmingham: The University, Edgbaston, 4.30 p.m. Dr. H. W. Thompson: 'Recent Developments and Applications of Infra-Red Spectroscopy.' (Jointly with University Chemical Society).

Glasgow: The University, 7.15 p.m. Prof. R. B. Woodward: 'Some Recent Advances in the Chemistry of Natural Products.'

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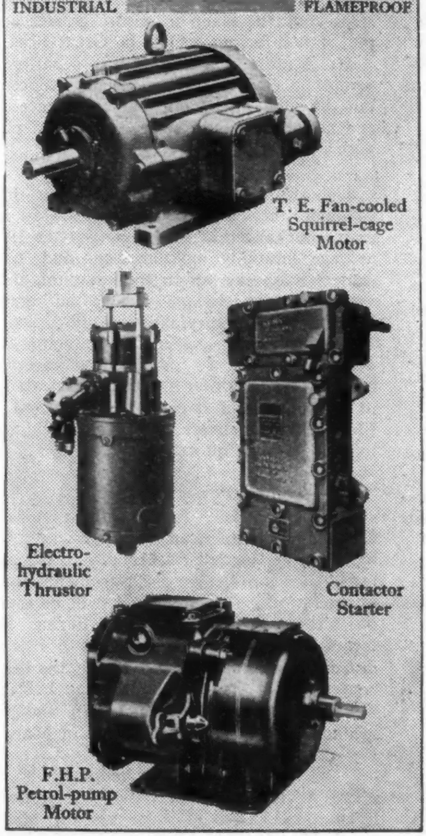

IN many industrial processes from oil refining to paint-spraying, flameproof electric equipment is essential. The BTH Trade Mark in association with the FLP symbol distinguishes a wide range of electric equipment of proved performance—Buxton-certified for service in atmospheres where inflammable vapours or gases may be present.

Products include motors, from petrol pump sizes up to 1,000 h.p.; a wide range of control gear; thrustors; switchgear; and lighting equipment.—

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HOME

Ardeer Club Dinner

Sir Alfred Egerton, head of the Imperial College of Science and Technology was guest at the annual dinner of the Ardeer Chemical Club held on 27 April. Composed of I.C.I. personnel, the Ardeer Chemical Club is probably unique, not only in its composition, but in the fact that it lives and thrives in a centre isolated from the larger cities.

Factory Closes Down

The fertilising manufacturing firm of John Peak and Co., of Newtown, Wigan, is to close down until further notice because of the grave shortages of sulphur. Their 40 workmen have received notice. 'It is a catastrophe,' said Mr. Harry Peak, general manager. 'From now on it's just a case of waiting and hoping until we get some further supplies of sulphuric acid.' The firm hope their workmen will be able to find temporary employment until it is possible to reinstate them. All orders in hand will be discharged before the works closes down.

Acetylene Factory Explosions

Five workmen employed in the acetylene factory of Industrial Gases (Scotland), Ltd., Hillington Industrial Estate, Glasgow, were injured on 27 April in a series of explosions which wrecked the premises. A number of gas-filled cylinders burst and were blown through the roof of a storage building, which afterwards caught fire. About 150 cylinders were in the premises when the explosions occurred.

Hopes Dashed

Hopes that uranium ore might be found in the Isle of Man in workable quantities were dashed on 25 April when the Forestry, Mines and Lands Board disclosed that recent finds studied by experts from the atomic energy division of the Geological Survey have resulted in an adverse report. The report states that a detailed study of the old mine dumps has shown that most of the island's derelict mines are entirely devoid of uranium. While specimens of uranium ore may be found by diligent research, the total amount present is too insignificant to be of an economic value.

Considered Unnecessary

In the House of Commons last week Sir Harold Roper, Member for Cornwall North, asked the Minister of Supply whether he would confer with representatives of the principal British mining firms as to what steps could be taken to ensure greater output of non-ferrous metals in Great Britain.

Mr. Strauss replied that his department would be glad to discuss specific proposals but he did not think 'a conference in general terms would serve any useful purpose.'

May Lead Allocation

The Ministry of Supply announces that, although the lead allocation for May remains unchanged at 90 per cent of the 1950 average monthly consumption and consumers may buy up to that amount, deliveries may be delayed during the month because of temporary shipping difficulties.

The Ministry expects to be able to deliver at least 80 per cent of average monthly consumption in 1950. The balance of 10 per cent, if it cannot be delivered in May, will be delivered in June in addition to that month's quota.

Three Power Conference

Representatives from the British, Canadian and American Atomic Energy projects met at Harwell on Monday to begin a fortnight's conference on instruments used in their work. The first week will be spent on technical discussions and during the second week visits will be made to British instrument manufacturers. This is the third conference of its kind. One was held at Oak Ridge, U.S.A., in May, 1949, and the second at Chalk River, Canada, in March, 1950.

Short Guide to London

Ernest Benn Limited on 19 April published one of the most popular of Muirhead's Blue Guides. THE SHORT GUIDE TO LONDON (15s. net) has sold well over 30,000 copies since 1945, and this latest edition has been brought entirely up-to-date, and will be in great demand from Festival visitors. Its 32 maps and plans, and detailed index give its user the greatest possible help in moving about London.

Company News

Imperial Chemical Industries Limited

The Board of Directors of Imperial Chemical Industries Limited announce that they have decided to recommend a final dividend on the Ordinary Stock of 9 per cent (less income tax at the United Kingdom standard rate for 1951/52) making, with the interim of 3 per cent a total of 12 per cent for the year 1950 (against 10 per cent for 1949).

The manufacturing assets of the company and its wholly-owned manufacturing subsidiaries at home have been revalued on the basis of replacement at current construction costs at 1 January 1950, reduced by reference to the age of the assets and their remaining useful lives. The depreciation charge for the year includes depreciation calculated to write off the new book values of these assets over their remaining lives, and amounts for 1950 to £8,694,823.

The Group Profit before taxation, for the year 1950, after charging the above depreciation, amounts to £31,018,457 (against £17,323,509 for 1949). The Group profit after taxation is £18,562,765. The net income of the company for the year 1950 is £16,843,912 (against £9,791,503 for 1949).

The surplus on revaluation of manufacturing assets amounts to £96,120,273 and has been transferred to Capital Reserve, partly as an amount of £58,227,768 freed on revaluation, being Central Obsolescence and Depreciation Provision and amounts written off such assets up to 31 December 1949, and partly by creating a Revaluation of Physical Assets Reserve in respect of the balance of £37,892,505.

After this transfer and after the 1950 appropriations from profits mentioned above, the total Capital Reserves of the company stand at £118,154,089 and the total Revenue Reserves at £26,368,816.

The final dividend on the Ordinary Stock will be payable on 16 June 1951 to members on the register on 7 May 1951. For the purpose of payment, transfers must be lodged not later than 30 April 1951.

The Twenty-fourth Ordinary General Meeting of the company will be held at Wigmore Hall, 36 Wigmore Street, London, W.1, on Thursday, 14 June, 1951.

JMS

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CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY GRANTS-IN-AID

THE Committee will, in July, allocate a limited number of Grants-in-Aid to young men and women employed in chemical works in or near London, who desire to extend their education for a career in chemical industry. Applicants must not be under 17 years of age and must have matriculation or its equivalent.

Applications should be made as soon as possible, whereupon forms will be issued requiring particulars of age, nature of employment and the manner in which the Grant would be used.

The Application Forms should be received, completed, before 25th May, 1951 by :-

THE CLERK OF THE SALTERS' COMPANY,
Salters' Institute of Industrial Chemistry,
36, Portland Place,
London, W.1.

THE INSTITUTION OF CHEMICAL ENGINEERS

27th.

ASSOCIATE MEMBERSHIP EXAMINATION

APPLICATION forms (returnable 1st June 1951) and particulars of the 27th Associate Membership Examination may be obtained from the Hon. Registrar, **INSTITUTION OF CHEMICAL ENGINEERS, 56, VICTORIA STREET, WESTMINSTER, LONDON, S.W.1.** *NOTE.*—Written and oral Examinations will be held in September, 1951. Home Papers will be issued in January, 1952.

SITUATIONS VACANT

A **CHEMICAL ENGINEER** is required by Chemical Manufacturers in S.W. Lancashire. Desirable qualifications are : A.M.I.Chem.E., or equivalent and experience in chemical plant design. For the successful applicant, the position is permanent and pensionable. Particulars of age, qualifications and experience should be sent to Box No. C.A. 3012, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

CROWN AGENTS FOR THE COLONIES

TEMPORARY LABORATORY SUPERINTENDENT (MALE OR FEMALE) required by the Government of Sierra Leone for Agricultural Chemical Research for 2 tours, each of 18 to 24 months, in the first instance. Commencing salary according to qualifications and experience in the scale £774 rising to £942 a year (including allowances). Outfit allowance £60. Gratuity of £25 for each 3 months service on satisfactory completion of contract. Alternatively employer's contributions to F.S.S.U. may be paid if desired in lieu of gratuity. Free passages and liberal leave on full salary. Candidates should have had sound laboratory training in a recognised laboratory and preferably be Associates of the Royal Institute of Chemistry or hold a degree in chemistry or a certificate of the Institute of Medical Laboratory Technology. Apply at once by letter, stating age, full names in block letters and full particulars of qualifications and experience and mentioning this paper to the **Crown Agents for the Colonies, 4 Millbank, London, S.W.1.,** quoting M.26602.G. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration.

SITUATIONS VACANT

A number of vacancies exist for **LABORATORY ASSISTANTS.** Higher Schools certificate or Matriculation, with some laboratory experience. Age 20-25. Starting wage £4 10s. to £7 15s. per week, according to age qualifications and experience. Applications to **Laboratory Manager, The Fullers' Earth Union Ltd., Copyhold Works, Redstone Hill, Redhill, Surrey.**

THE Division of Atomic Energy (Production) invites applications for the post of **CHEMIST** or **ENGINEER I** in the Production Planning Section at Risley headquarters. This section is concerned with the control of manufacturing programmes at three large factories situated at Salwick, Near Preston, Sellafield, Cumberland, and Capenhurst, Near Chester.

The work involves the detailing of production programmes; reviewing plant efficiencies and costs, the control of raw and processed material usages; the preparation of flow sheets and the control of processed products and stocks. The processes are mainly chemical but are part engineering in nature.

Applicants should have an Honours Degree in Chemistry or Engineering, or Associateship or Corporate Membership (as appropriate) of one of the recognised Professional Institutes or Institutions. They must have had industrial production experience and be fully conversant with this class of work.

Salary will be assessed according to qualifications and experience within the range £997—£1,192 p.a. A voluntary Superannuation Scheme is in operation.

A house will be available within a reasonable time.

Applications to **Ministry of Supply, D.At.En.(P), Risley, Nr. Warrington, Lancs.**
Rs. 5585-25-JH.

VACANCIES exist for three **SHIFT SUPERVISORS.** Qualifications Inter B.Sc. or equivalent, with some chemical works experience. Salary range £525-£650 p.a., according to age, qualifications and experience. Applications should be made in writing to **General Works Manager, The Fullers' Earth Union Ltd., "Patteson" Court, Nutfield Road, Redhill, Surrey.**

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SENIOR 45 in. **PACKING M/C.,** for powder materials Jackson & Crockatt, motorized 400/3/50. Operation on special 'receding' worm principle. Will pack large variety of jars, bottles, tins or cartons.
JAR AND BOTTLE CAPPER by Gravill. Cap. approx. 36 per min. with adjustment for various sizes. Motorized 220/240/1/50, through reduction gear. Unit mounted on C.I. stand with castor wheels.
LABELLING M/C by Dawson. Cap. 30 labels per min. singles. Motorized 220V. D.C., foot pedal operated (continuous or single op.) Fitted gumming rolls and various bottle rests.
BOTTLE RINSING M/C by Thomas & Hill. Chain conveyor type, 12 ft. centres double row bottle fixtures 132 head. Rotary jet rinsing. Cap. 150 dozen half or pint bottles per hour. Motorized 400/3/50.
LABELLING M/C by Rawsons, for pint or 16 oz. size flat or square. Cap. 24-30 per min. Numbering device. Motorized 400/3/50. Unit mounted on rubber tyred wheels.
6 ELECTRIC MAGNETIC SEPARATORS by H. G. Richardson. Reco type No. D.83 . 180V. 1 amp.
Carton **FILLING, PACKING, WRAPPING AND LABELLING M/C** by Societe Industrielle Suisse, adjustable for cartons from 73 mm. sq. × 38 mm. to 65.6 mm. sq. × 38 mm. Motorized 400/3/50. Complete with label attachments and heat sealing device. Conveyor feed approx. 55 per min.

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Six Stainless Steel Gas heated **JAC. PANS,** each 18 gallons, in batteries of 3 or separate units.
Pair Watson Laidlaw **HYDROS** with 30 in. monel basket, bottom discharge, 400/3/50.

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1½, 2½ and 3½ size belt-driven **DISINTEGRATORS** by Christy & Norris or Harrison Carter.

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Large unjacketed **WERNER MIXER,** belt and gear driven, hand tipping, double "Z" arms, pans 53 in. by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with handwheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the top of the tipping screw.

No. 209 One **HORIZONTAL "U"-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Further details and prices upon application

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IT is desired to secure the full commercial development in the United Kingdom of BRITISH PATENT No. 598177 which relates to **"PROCESS FOR THE PRODUCTION OF PANTOTHENIC ACID"** either by way of the grant of licences or otherwise on terms acceptable to the Patentee. Interested parties desiring copies of the patent specifications should apply to **STEVENS, LANGNER, PARRY & ROLLINSON, 5 to 9 Quality Court, Chancery Lane, London, W.C.2.**

THE Proprietor of Patent No. 599,683 for **"IMPROVEMENTS RELATING TO THE MANUFACTURE AND UTILIZATION OF COLD SETTING POLYHYDRIC PHENOLIC ALDEHYDE ADHESIVES"** desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to **HASELTINE, LAKE & CO., 28 Southampton Buildings, Chancery Lane, London, W,C.2.**

IT is desired to secure the full commercial development in the United Kingdom of BRITISH PATENT No. 600,796 which relates to **" FLUIDIZING PROCESS AND APPARATUS FOR TREATING COMMINUTED SOLID MATERIALS,"** either by way of the grant of licences or otherwise on terms acceptable to the Patentee. Interested parties desiring copies of the patent specifications should apply to **STEVENS, LANGNER, PARRY & ROLLINSON, 5 to 9 Quality Court, Chancery Lane, London, W.C.2.**

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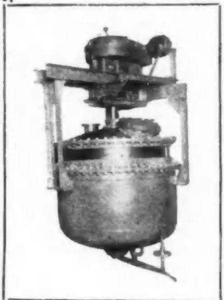

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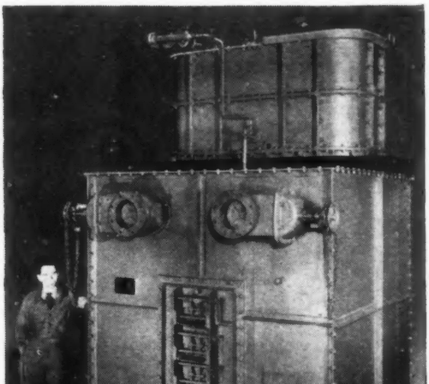

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